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THE CANADIAN

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INCLUDING THE PROCEEDINGS OF

THE NATURAL HISTORY SOCIETY OF MONTREAL,

AND REPLACING

THE CANADIAN NATURALIST.

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DEVONIAN PLANTS.

THE

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Additional Notes on Devonian Plants from Scotland.

By D. P. Penhallow, Professor of Botany, McGill University.

In a recent communication[1] I had an opportunity of discussing the structure and probable affinities of *Parka decipiens* on the basis of material supplied by Mr. Reid and Mr. Graham, of Scotland. Lately, the former gentleman has supplemented his previous large supplies of fossils by a number of interesting specimens which have reached me through Sir Wm. Dawson. This new material is in some respects the same as that already examined, but some of the specimens are much better, while others represent structures more or less wholly wanting in the first collection, and thus enable me to now complete the connection between the different forms in which *P. decipiens* occurs.

The views already expressed are not altered in any essential feature by this additional material, while many of the deductions drawn are verified and strengthened. I have, therefore, deemed it expedient to supplement my previous paper by a presentation of these additional facts, and also to discuss in connection therewith certain other species of Devonian plants associated with *Parka*.

[1] Trans. Royal Soc. Can. IX. iv.

PARKA DECIPIENS. Flem.

Bib.: Jn'l. Geol. Soc. XV. 407; XX. 413; XVII. 534; Miller, Testimony of the Rocks, 1857, 446; Cheek's Edinburgh Journal, 1831; Nature, April 10th, 1890; Page's Advanced Text-book, 1856, 127; Trans. Royal Soc. Can. IX. iv.

In the specimens recently received *Parka decipiens* is represented by both stems and fruit. In the slates from Myreton are two carbonized stems 5 and 5.5 c m. wide. Both are strongly rugose and folded back and forth as if in a highly pliable or partly decaying state when imbedded. The carbonaceous matter is much thicker and more generally abundant than in the case of any of the other specimens examined by me. In the larger of the two, which measured 78 c.m. in length, there were observed to be five rounded pits with an average diameter of 8 mm., strongly suggestive of the possible position of roots. No positive evidence of branches could be obtained.

In a specimen of sandstone from Rescobie, there was found an irregular mass, possibly the rhizome of *P. decipiens*, showing numerous small, round pits and processes about 4 mm. in diameter, also presenting the aspect of root stumps, but from the imperfect state of preservation it was quite impossible to trace any connection between it and the well defined stems of other specimens. From Rescobie there were also obtained two good impressions of masses of sporangia. The remains are ferruginous and belong to the type of the species.

PARKA DECIPIENS, Flem., var. MEDIA, Pen.

This varietal form is represented by stems which were not included in the material upon which the original description was based. They occur in the slates from Myreton, are slightly carbonized and measure from 15–20 mm. in width. In one case there was an imperfectly defined branching. The sandstones from Rescobie also contain ferruginous impressions of stems of the same width—15 mm.—which are distinctly branching, and in one case

there is a strongly defined central axis, suggesting that these stems were possessed of a pith which became infiltrated with sand before the surrounding parts collapsed. There was thus preserved a central axis of somewhat coarse sandstone, which now stands prominently above the exterior and flattened structure.

The sporocarps of this variety are represented by very imperfect impressions. In my former paper,[1] I spoke of these remains as showing a distinct radial structure, but having no direct connection with *Parka*—association and their peculiar structure being the only grounds on which relationship could be established. The present material renders a more definite expression on this point possible, and an excellent figure showing not only their characteristic structure, but also the fact that the sporangia are contained in them, is given by Miller,[2] who also quotes Dr. Fleming[3] as saying that "these organisms occur in the form of circular patches, not equalling an inch in diameter, and composed of numerous smaller, contiguous pieces. They are not unlike what might be expected to result from a compressed berry such as a bramble or the rasp." Our original contention, therefore, that these circular bodies with radial structure represent the sporocarps of *Parka*, may be considered as well founded.

PARKA DECIPIENS, Flem., var. MINOR, Pen.

This variety is represented by the full sporocarps and also by branching stems and leaves similar to those already described. The sporocarps answer to all the characteristics already assigned them and further comment is not necessary.

The stems (Plate I, fig. 3) show the usual rugose surface and characteristic branching, and in the figure here given the generic characteristics of form are well shown. Near the base of the figure are what appears to be two branches. These, on closer inspection, prove to be separate structures lying *across* the stem of *Parka*. The lower

[1] Trans. Royal Soc. Can. IX. iv.
[2] Testimony of the Rocks, 443; fig. 121.
[3] Cheek's Edinburgh Journal, 1831.

one answers to what Salter has described, from the same formation, as roots,[1] but which are probably referable to *Psilophyton.* To this same category—roots—Kidston refers a plant figured by Salter[2] some years ago, but which would appear from the figure given to belong more properly to *Parka decipiens* var. *minor.*

A revision of the descriptions of *Parka* to embrace the new facts at hand would be as follows:—

GENUS PARKA. Flem.

Aquatic plants with creeping, rugose stems, linear leaves and sessile sporocarps bearing two kinds of sporangia. Sporangia, 2 mm. in diameter; macrospores, 40 μ; microspores, 15 μ.

These fossils occur in micaceous slaty or sandy shales. Their most characteristic appearance is that of oval bodies or fragmentary masses showing rounded discs or impressions of such. They are sometimes carbonized, often ferruginous. From the Lower Devonian of Myreton, Rescobie, Blairgowrie, Thurso and Caithness, Scotland. Reid and Graham.

PARKA DECIPIENS, Flem. Stems about 4–5 c.m. in diameter, showing branching about 11 c.m. distant. Leaves, linear, 1 c.m. broad, with somewhat rounded terminations. Sporocarps, oval, 3.5×5.5 c.m., being more or less conspicuous impressions of the contained sporangia.

The sporocarps are sometimes complete, though generally found in fragments, either carbonized or ferruginous.

α. MEDIA, Pen. Stems, 15–20 mm. wide, and with the oval sporocarps nearly entire, 13×20 mm. broad, and often showing a distinctly radial reticulation. Impressions of the sporangia distinct, usually carbonaceous. Leaves unknown.

β. MINOR, Pen. Stems, 4 mm. broad, with branches 2.5–3 c.m. distant. Leaves linear, 1.5–2 mm. broad, sometimes finely veined, Sporocarps oval, 6–11 mm. broad. Impressions of the sporangia distinct, usually carbonized.

[1] Jn'l. Geol. Soc., Plate V, figs. 3, 4.
[2] *Ibid,* Plate V, fig. 6.
British Mus. Cat. Pal. Plants, 233.

LYCOPODITES MILLERI. Salter.

Bib: Quart. Jn'l. Geol. Soc. XIV. 75, pl. V. 8 a, b, XV. 407 fig. 3, XXXIII, 215, 216; Miller, Testimony of the Rocks, 1857, 55, fig. 12; Kidston, Brit. Mus. Cat. Pal. Plants, 232; Dawson, Can. Nat. VIII, Feb. 1878, fig. c.; Solms-Laubach, Fos. Bot.

This species is represented by a carbonised stem 8 mm. wide and 24 cm. long, somewhat thicker at the lower end. There are two obvious branches which divide dichotomously. Impressions of scales are obvious though poorly defined—for the most part obscure. The whole aspect of the plant reminds one strongly of *Lycopodium clavatum* as already noted by previous observers. The leaves are evidently narrowly lanceolate and acute. Comparison with another specimen from Caithness, now in the Peter Redpath Museum of McGill College, and with Salter's description of this plant,[1] shows complete identity. It is an unfortunate circumstance, however, that in none of the specimens so far collected, has the fruit been obtained. If a true lycopod, then from its resemblance to recent species, we might conceive the fruit to have been produced as a special spike raised on a more or less elongated branch as in *Lycopodium clavatum*. But in the present state of our knowledge of of this plant, such views must necessarily be regarded as purely conjectural.

Since this plant was first described by Salter, various attempts have been to identify it with *Lepidodendron* and *Psilophyton*,[2] in consequence of which some confusion has arisen relative to its true characteristics. An examination of all the specimens now in the Dawson collection of McGill College, and careful comparison with type specimens of *Lepidodendron* and *Psilophyton* in the same collection, as well as a review of the descriptions and figures published from time to time leads me to the conclusion that the name *Lycopodites* as assigned to this plant by Salter must be maintained, and this view is strengthened by comparison with *L. matthewi*, Dn., and *L. richardsoni*, Dn.[3]

[1] Jn'l. Geol. Soc. XIV, 75.
[2] Kidston, Brit. Mus. Cat. Pal. Plants, 232.
[3] Jn'l. Geol. Soc. XIV., 75 Plate V., figs 8 a, b.

In the original description of this plant by Salter,[1] he states that "the leaves are very indistinct, but about $\frac{1}{8}$ of an inch long, lancolate (obtuse ?) and much curved upward to one side (the upper side probably). There is some indication of their being set on in spiral lines, instead of quincuncially." This points directly to the probability of the plant having a prostrate, creeping habit of growth after the manner of our modern *Lycopodium clavatum*, and is a view well borne out by all the specimens which have passed through my hands. This resemblance is also heightened by the fact that the extremities of the branches in *L. milleri* are often somewhat swollen exactly as may be seen in a growing plant of *Lycopodium clavatum*. This, Sir Wm. Dawson has regarded as the possible fruit,[2] but I should rather consider it as representing the terminal bud. The leaves show no distinct articulations with the stem nor do they, on removal, leave upon the latter well defined scars as in *Lepidodendron*, though the spiral arrangement common to both these genera might be regarded as an indication of affinity, but of very subordinate value. While the character of the fruit in *Lepidodendron* is fairly well known,[3] it is as pointed out, wholly unknown in *Lycopodites*. A distinction of this genera must for the present, therefore, be based upon the superficial structure as represented in the leaves, leaf scars and general form and aspect of the plant.

From this point of view I have carefully compared *Lycopodites milleri* with *Lepidodendron gaspianum* which Kidston regards as identical,[4] employing for this purpose specimens preserved in the same matrix, *i.e.*, sandstone shale, in order to ensure that the plants were subjected to similar conditions. I find that while in the former, the leaves closely overlap so as to render their points of inser-

[1] Jn'l. Geo. Soc. XVIII, 314; XIX, 461 Pl. XVIII. fig. 112; Can. Nat. VI, 179, fig. 10; Foss. Plants Dev. and Up. Sil., 1871, 34, 35, Pl. VII, fig. 81, and VIII, 85, 86, 87.

[2] Can. Nat. VIII, p. 383.

[3] Rept. Geol. Surv. of Canada, 1871; Dev. and Up. Sil. Plants 33, Pl. VIII., fig. 84.

[4] Brit. Mus. Cat. Pal. Plants, 232.

tion somewhat obscure and there are no leaf scars or distinct articulations and the spiral arrangement, while possible, is obscure, in the latter the leaf scars and articulations are prominent, the leaf positions distinctly separated and the arrangement strongly spiral. To this we may also add that while in *Lycopodites milleri* the habit of growth was prostrate in *Lepidodendron gaspianum* it was erect. The entire aspect of the two plants is quite distinct and they should, I think, be so considered.

The genus *Psilophyton*, as described by Sir Wm. Dawson,[1] represents again quite a distinct group of plants. Referring to the description of the plants upon which the genus was founded, I find it to indicate "Stems branching dichotomously, and covered with interrupted ridges. Leaves rudimentary or short, rigid and pointed; in barren stems, numerous and spirally arranged; in fertile stems and branchlets sparsely scattered or absent; in decorticated specimens represented by minute punctate scars. Young branches circinate; rhizomata cylindrical, covered with hairs or ramenta, and having circular areoles irregularly disposed, giving origin to slender, cylindrical rootlets. Internal structure, an axis of scalariform vessels, surrounded by a cylinder of parenchymatous cells, and by an outer cylinder of elongated woody cells. Fructification consisting of naked, oval spore cases, borne usually in pairs on slender, curved pedicels, either lateral or terminal."

By comparison with the type specimens in the Peter Redpath Museum, and both with *Lycopodites milleri*, I find that there is no ground upon which the two can be properly identified as belonging to the same genus. Indeed, the differences are even more marked than those so readily observable between *Lycopodites* and *Lepidodendron*. The interrupted ridges and circular areoles of *Psilophyton* as appear in the description above quoted, are absolutely wanting in the specimens of *Lycopodites* in my hands. Again, the greater number of specimens of *Psilophyton* show it to

[1] Rept. Geol. Surv. Can., Foss. Plants of Dev. & Up. Sil. 1871, p. 37; Jn'l. Geol. Soc. XV, 478, 479; Can. Nat. VIII, p. 379.

have been distinctly woody, while all the specimens of *Lycopodites* so far brought to my notice indicate that it was of a much more herbaceous character. To these differences we may add that the strongly recurved branchlets and the peculiar mode of ramification; also the pair of spore cases on slender, curved pedicels as found in the former,[1] are wholly wanting in the latter,[2] giving to the two plants widely different aspects.

Sir Wm. Dawson assures me that his reconstruction of *Psilophyton* was based upon laborious explorations in the beds where it was found. By systematic excavations the various parts of the plant were traced from the roots upward, and their connection thus established. In the absence of complete plants, such a method of recovery is well adapted to guarantee accuracy in the final results. I cannot but feel, therefore, that the figure of *Psilophyton princeps*[3] as the type of the genus, is correct as to the general form and habit of growth. In such case we cannot fail to see that the genus is quite different from the plants now included under *Lycopodites* as represented in the figures already given.

Lepidodendron nothum, Salter, is again distinct from *L. gaspianum*, Dn., though approaching it much nearer than it does to *Lycopodites milleri* on much the same grounds as already given. I have, however, not had access to a good type specimen of this plant, and must therefore advance an opinion with some degree of reserve.

Lycopodites reidii, n. sp.

Plate I. Fig. 2.

In association with *L. milleri* from Caithness, there was obtained in Reid's collection another lycopodiaceous plant, which, however, differs from any of the above genus here-

[1] Rept. Geol. Surv Can. 1871, Dev. & Up. Sil. Plants, Plate IX, figs. 102, 103; Jn'l. Geol. Soc. XV, 479, fig. li.

[2] *Ibid* XIV, Plate V, fig. 8a.

[3] Jn'l. Geol. Soc. XV. 479, li; Reports. Geol. Surv. Can. Foss. Plants of Dev. & Up. Sil. Pls. IX, X, XI.

tofore described in important particulars. The specimen is a carbonized fertile stem 8 c.m. long and 6 mm. wide, showing a short branch near the base. The leaves are narrowly lanceolate, acute and somewhat spreading. The basal articulation of the scales is obscure, but among these organs, sometimes strictly basal or again scattered irregularly over the entire remains, are carbonized sporangia 1 mm. in diameter. The indications of the specimen point to a spiral arrangement of the leaves. The whole aspect of the plant is strongly suggestive of *Lycopodium selago*, both in its general form and the way the fruit is produced. (Plate I, Fig. 2.) The accompanying figure, giving an ideal

section of the fertile axis, will convey some idea of the relation of sporangia, leaves and central axis. I therefore deem it expedient to distinguish it by a separate name as *L. reidii*. The description would then be as follows:

Lycopodites reidii, n. sp.

Stems branching. Leaves disposed spirally, narrowly lanceolate, acute, 5 mm. long, 1 mm. broad at the base. Sporangia globular, 1 mm. broad.

Devonian of Scotland. Reid.

ZOSTEROPHYLLUM MYRETONIANUM, gen. et sp. nov.

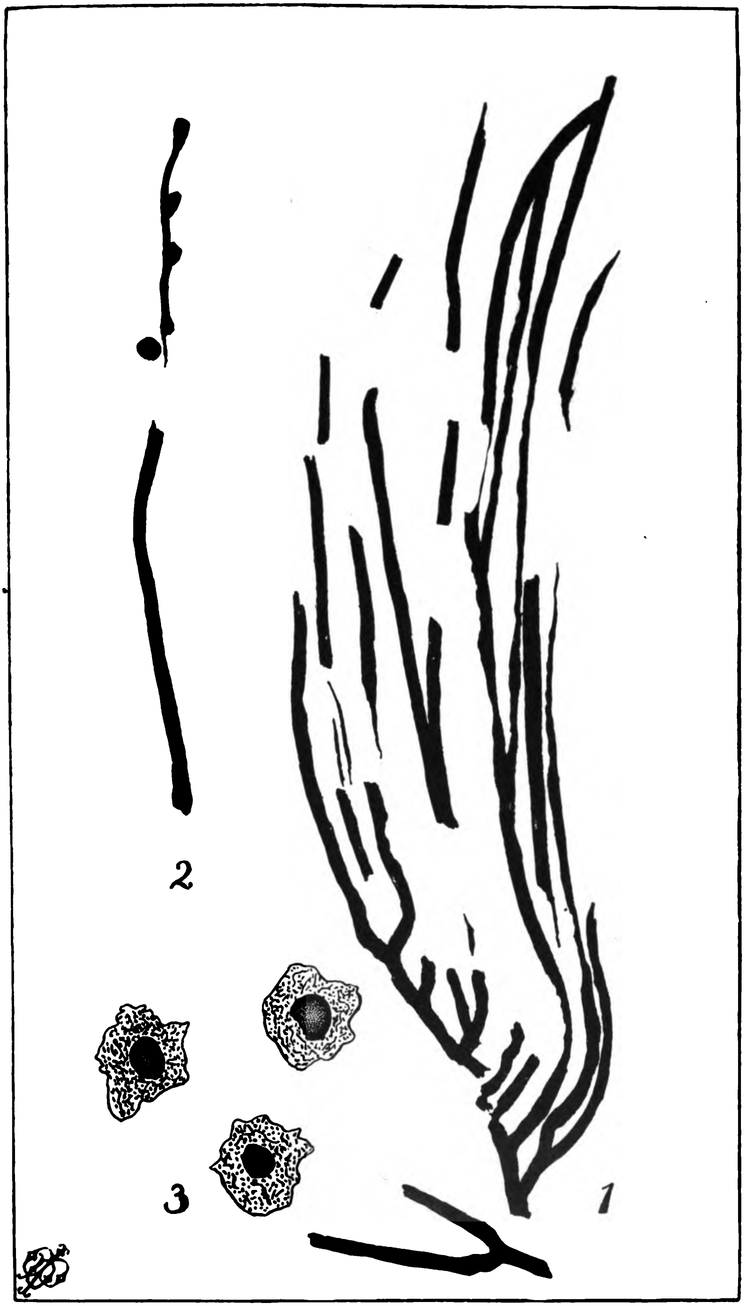
In my former paper [1] I described certain impressions in the slatey shales of Myreton as linear leaves often showing longitudinal striations like a fine parallel veining, and showed that in one specimen received from Mr. Reid from

[1] Trans. R. Soc. Can. IX, iv.

Caithness, these leaves were aggregated in the form of a tuft apparently proceeding from a common horizontal stem. Miller exactly describes their appearance [1] when he speaks of them as "ribbon-like fronds or branches which rose by dozens from a common root, like the fronds of Zostera, and somewhat resembled a scourge of cords fastened to a handle." These remains he refers to as fucoids. The peculiar appearance they present has more than once been commented upon, and in my former paper on *Parka decipiens*, I was inclined to regard them as possibly representing the leaves of *β. minor*. So far as the material then examined would enable me to judge, there was no good ground for disputing this view. The material now in hand, however, is of such a nature as to justify an entirely different view and lead me to consider them the remains of a distinct plant, which, however, is associated with leaves of *P. decipiens β. minor* and with stems of *Psilophyton*, the parts of one often bearing a somewhat strong resemblance to parts of the others, when such parts are considered separately and not in connection with the entire plant.

In a large flag from Myreton, one of these plants is found. As will be seen from the figure, it shows a central axis—probably horizontal, from which there arise simple and linear leaf-like organs, also other linear organs which repeatedly branch. (Plate II, fig. 1.) The origin of the ribbon-like leaves from a horizontal stem is very suggestive, as Miller has pointed out, of *Zostera*, but in comparing this fossil with specimens of *Zostera* in the flowering stage, I find the resemblance to be even more striking, since the simple filaments are the counterpart of the leaves of that plant and the branching filaments are strongly suggestive of the inflorescence. Indeed the suggestion is so strong that were we to take a handful of *Zostera* in the flowering state and throw it down to be afterwards covered up by mud and hardened, it would present precisely the aspect of the fossil in question. It is hardly to be supposed that flowering plants flourished at the remote period to which this fossil

[1] Testimony of the Rocks, 446.



Devonian Plants.

belongs, and there is no present evidence to show that they did, but I think the unique character of this plant will justify us in regarding it as of a new genus, for which I would suggest the name *Zosterophyllum*, to be specifically known as *myretonianum*. It must be clearly understood, however, that the application of this generic name is not intended to denote affinity with *Zostera*, but merely a general resemblance.

Closely associated with *Zosterophyllum*, I found a branch bearing rounded and ovoid sporangia like bodies (Plate I, fig. 1) which are given in the figure of natural size. It will be seen that there are two conspicuous lateral processes or branches, the uppermost of which bears a distinctly globular body or sporangium (?). Above the second sporangium there is a short fragment of stem which probably represents a continuation of the same axis. The sporangia show no subtending bracts, nor is any structure visible. They are in each case completely flattened out so that only the impression remains.

A second fruiting branch of the same nature, but with less mature fruit, is shown in the drawing of natural size (Plate II, fig. 2). This is much more intimately associated with *Zosterophyllum* than the preceding, being completely surrounded by leaves and branches from which it was at first difficult to separate it. Both agree in their essential features, but as in neither no actual connection was found to exist with *Zosterophyllum*, it is impossible to say what the precise relationship is, though from their general form and structure we might infer that these fruiting spikes were thrown up directly from the horizontal rhizome.

It is highly probable that the round, seed-like bodies (Plate II, fig. 3), which also occur abundantly, and which I was unable in my former paper,[1] to satisfactorily account for, are the same fruits in a mature condition. These bodies show a very slight carbonaceous film surrounding a mass of slaty stone as a nucleus, thus lending probability to the view that they represent sporangia, the contents of which

[1] Trans. R. Soc. Can. IX, IV, Plate I, fig. 6.

have been replaced. I think it is also safe to consider the structure figured by Salter,[1] but referred to by him as "rootlets with lateral tubercles," as of the same nature. All of the bodies may be regarded, therefore, at least provisionally, as the fruit of *Zosterophyllum.*

Finally, the remains so far submitted to us show that the plants were not strongly vascular, but that they were, on the other hand, very soft and herbaceous.

The characters of this plant, so far as at present determinable, may be stated in the following terms:

GENUS ZOSTEROPHYLLUM, n. gen.

Aquatic plants with creeping stems, from which arise narrow dichotomous branches and narrow linear leaves of the aspect of *Zostera.* Fruit, an ovoid or spherical sporangium (?), produced on short pedicels, without subtending bracts, from a single axis, the whole forming a loose spike.

Lower Devonian of Myreton, Scotland. Reid.

Z. MYRETONIANUM, n. sp. Stem and branches, 2 mm. in diameter. Leaves linear, 1.5–2 mm. wide, often showing an inconspicuous veining. Sporangia, 2.5–4 mm. broad, round or ovoid. Superficial structure, none.

In connection with the above, it may also be well to place on record the suggestion of Sir William Dawson that some of the narrow *Zostera*-like leaves described by him from Gaspé and Baie des Chaleurs, and provisionally referred to his species *Cordaites angustifolia,* may also belong to the genus *Zosterophyllum* as above described. Specimens in his collection would seem to corroborate this view.

EXPLANATION OF PLATES.

Plate I.

Fig. 1. Fertile stem of ZOSTEROPHYLLUM MYRETONIANUM, showing three fruit bodies. Natural size.

Fig. 2. Fertile branch of LYCOPODITES REIDII. Natural size.

[1] Jn'l. Geol. Soc. XIV, Pl. V, figs. 7 a, b.

Fig. 3. Branching stem of PARKA DECIPIENS β MINOR, showing at the base, a stem of PSILOPHYTON and a fragment of PARKA lying across it. Natural size.

Plate II.

Fig. 1. Plant of ZOSTEROPHYLLUM MYRETONIANUM. Natural size.

Fig. 2. Fertile stem of Z. MYRETONIANUM (?) showing immature fruit bodies. Natural size.

Fig. 3. Separate and mature fruit bodies of Z. MYRETONIANUM (?). Natural size.

SOME LAKE AND RIVER TEMPERATURES.

By A. T. DRUMMOND.

In *Nature* and this journal, I have already drawn attention to the fact that the Georgian Bay is, in its main expanse, a large body of cold water whose temperature, at its greater depths, is not much influenced by the heat of summer, whilst, on the other hand, the Central and Southern Basins of Lake Huron, although also receiving surplus waters from Lake Superior, stand in the line of inflow of the warmer waters from Lake Michigan and of their ultimate exit by way of the River St. Clair to the lower lakes, and are consequently somewhat warmer basins.

Staff-Commander Boulton, R N., has been good enough to communicate some further records of temperature made during the season of 1890 in the Georgian Bay and the channel north of the Manitoulin Islands. These, taken in connection with his former results, justify certain conclusions to which reference will be made in this paper.[1]

PARRY SOUND.

In the course of his soundings during 1890 in the deep and wide but land-locked harbor of Parry Sound, on the eastern coast of the Georgian Bay, with its fringe of islands

[1] The readings in this paper are all from Fahrenheit's scale.

and comparatively shallow waters in front, some temperatures were taken, at different periods of the summer, which establish the fact that notwithstanding the presence of islands in the sound, and of land on all sides, at no place more than two to three miles distant, the deep depressions or pools in the bottom of the sound, in some places exceeding sixty fathoms in depth, retain their cold water throughout the year. The change observed at the bottom between the beginning of May and the end of August did not exceed 3.5°, whilst in the same period the variation at the surface was 25.5°. The observations have sufficient interest to be given here:—

Time.	Depth.	Air.	Surface.	Bottom.	Sky.
May 2nd, noon....	62 fms.	48°	36 2°	35.7°	Clear
Aug. 23rd, 5 p.m..	48 "	64°	61.7°	39.2°	Some clouds
Oct. 15th, 4.10 p.m.	57 "	57°	53.5°	39°	Overcast

How far the cold waters of these deeper pools in a land-locked harbor like Parry Sound, which is largely free from the direct influence of outside currents, are subject in summer to much change, not merely in temperature but through circulation, is worth considering.

Referring to the Georgian Bay generally, Commander Boulton infers from the temperatures which he has taken that, in the early spring of the year, the whole column of water is at nearly the surface temperature, and that the effect of the summer's heat is to warm up the bottom water to about the temperature of water at its greatest density, viz., 39.2°.

INFLUENCE OF LAKE SUPERIOR WATERS ON GEORGIAN BAY TEMPERATURES.

In considering why the bottom waters in the Georgian Bay retain so low a temperature throughout the summer, regard must be had to the direction of the inflow of the waters from both Lake Superior and Lake Michigan. A reference to a chart of the Great Lakes will help to explain this. The waters of Lake Superior—always cold—find

their outlet to Lake Huron through the River St. Mary. The island of St. Joseph divides the river, as it joins Lake Huron, into two channels, one of which transmits its waters partly through the Detour into the Central Basin of the lake, and partly into what might be termed the Manitoulin Basin, on the north side of the Manitoulin Islands, whilst the other channel guides its waters entirely into this latter basin. It at once suggests itself that the waters of this Manitoulin Basin must be cold, and that the flow of these colder waters, whilst in part to the Central Basin of Lake Huron by the channels between the islands, is more probably largely along the north side of these islands and into the Georgian Bay, thus continuously keeping up the supply of cold water, which is so conspicuous a feature in that bay. Commander Boulton's records seem to me to help this suggestion. Thus, in the Manitoulin Basin, north of Cockburn Island, on June 3rd, 1890, at 10.30 a.m., with a cloudy sky and the air at 54°, the surface water indicated 44.7°, whilst the temperature at 29 fathoms was 39°; and, again, at another point nearer Cockburn Island, at 8.30 a.m., on the next day, when the sky was clear and the air at 66°, the surface of the water was 46.5°, whilst the bottom at 18 fathoms indicated 39.7°.

Again, the preponderating current in the channel between La Cloche Island and the north shore of Manitoulin Island, at the point known as Little Current, is, Commander Boulton informs me, towards the Georgian Bay. As an easterly wind may reverse its direction for the time, he suggests that the easterly current might be merely surface-drift, due to the prevalence of westerly winds. My own impression is that it will be found to be a permanent, deep current, flowing towards the Georgian Bay.

It is, however, also suggestive that the cold waters from Lake Superior which do pass through the Detour, and the channels between the Manitoulin Islands into the Central Basin of Lake Huron, are not immediately incorporated with the warmer Michigan outflow, but trend in an easterly and south-easterly direction towards the Georgian Bay and

Bruce Peninsula, and constitute a barrier to the extension easterly of these warmer Michigan waters. The few surface and bottom readings obtained by the United States Lake Survey would appear to justify the suggestion, as the waters in the broad line of flow from the Straits of Mackinac to Sarnia indicated 10° warmer at the bottom and 6° to 7° at the surface than those in the Central Basin to the east of this general line.

YAMASKA RIVER.

Two or three weeks holiday, spent last August at Yamaska Mountain, on the banks of the Yamaska River, gave me the opportunity of making numerous thermometrical tests of the relations between the water and the overlying air, and, inferentially, of the influence which water in larger bodies must have on the temperature and agricultural capabilities of the neighboring land.

The river here is from 300 to 400 feet wide and from 10 to 15 feet in depth. and flows in a very serpentine course through a broad stretch of level country, the only conspicuous break immediately near being the isolated Yamaska Mountain, which, about half a mile back from the river, rises precipitously to a height of about 900 feet, and is, from summit to base, clothed with pines, spruces, maples and other trees. On the Abbotsford side, the incline is gradual, and affords both room and protection for the extensive orchards which there are laid out with a semblance of mathematical exactitude on the mountain side. Viewed from the mountain, the great plain here has been almost denuded of its woods, and, with the tracery of unsightly fences, is at every point subdivided into cultivated farms. The wind has, therefore, but little to break its force as it sweeps over the great plain and past the mountain sides. Where our headquarters were on the banks of the river, in full view of the sombre mountain which lay about half a mile away, the gales were frequent, sometimes violent. The river, however, flowed in its tortuous course between precipitous banks of from 15 to 20 feet high, and generally

presented a comparatively unruffled surface, which favored the taking of temperatures.

In a shallow river like the Yamaska, whose waters are readily swollen by very heavy rains, and whose course is broken here and there by milldams, the temperature of the water is necessarily somewhat uniform, excepting so far as the surface may be influenced by the sun's rays by day or by the coolness of the night air. Thus, on days when the sky was continuously overcast, this uniformity was frequently observable, whilst in the bright sunshine of early August, the surface would indicate from 1° to 2° higher than at about four feet depth. The general temperature of the water at that depth in the earlier part of the month was about 77°, but by September 8th it had fallen gradually to 68°.

INFLUENCE OF TEMPERATURE OF WATER ON THE IMMEDIATELY OVERLYING AIR.

The temperature of the river water was about 6° to 7° higher than Lake Ontario waters at about the same depth and the same period in August would be, but the protection which the river banks afforded from the wind, and the, at oft times, comparatively unruffled surface, aided in rendering the tests made here more definite than, on the open lake, they could generally have been. The readings were taken (1) at one inch below the surface of the water, (2) in the air one inch above the surface, (3) at one foot and one foot and a-half above the surface, and (4) on the top of the bank at about sixteen feet above the river level. Cloudy days were selected, though some tests were made at sunset.

The features of interest which from the first presented themselves were, as might be expected, the much higher temperature of the surface water over the immediately overlying stratum of air, and the extreme variation in this difference of temperature. It was not uncommon to find this difference amounting to 6° @ 8°, although it sometimes was as low as half a degree, and on one occasion, at 7.45 p.m. on the 13th August, rose to nearly 18°, and was then accom-

panied by a light vapour over the water. In the ascent from this stratum of air directly in contact with the water, to the top of the bank, there was a constantly varying but gradually lower temperature. At one and a-half feet above the water the readings fluctuated between .5° and 3° lower than at one inch above the water, and on the top of the bank these fluctuations ranged from .5° to 4.5° lower than at one inch. In only one case was the reading on the top of the bank higher in range. Four illustrations are here given to show the relative temperatures (1) during a continuous dense fog, (2) and (3) at different hours on the same cloudy day, and (4) at sunset on a cloudy cool day:

	(1) 9 a.m. Aug. 16. dense fog.	(2) 4 p.m. Aug. 31, cloudy.	(3) 7 p.m. Aug. 31, cloudy—water absolutely calm.	(4) 7.15 p.m. Aug. 28, cloudy—cool.
Water at 3 ft..........	71.75°	68°	.....	67.2°
Water at 1 in..........	71.75°	68°	68.25°	66.5°
Air 1 in. above water..	68.5°	66°	66.25°	57°
" 1 ft. " " ..	66.75°	63.5°	61.5°	55.5°
" 8 ft. " " ..	.....	63°	.....	....
" 16 ft. " " ..	65.75°	62°	60.25°	55°

In the case of the second illustration, when the thermometer at 8 ft. up the bank was placed upon the moist ground there, the mercury rose from 63° to 64.5°. On the top of the bank, about 300 ft. inland in the fields away from the woods, it remained at 62°, but in the woods 200 ft. nearer the bank of the river it fell to 60.5°, the thermometer in each case being placed at about 18 in. above the ground.

CONCLUSIONS.

The readings are suggestive of the condition of probably most of the tributaries, from the south, of the St. Lawrence and Great Lakes during the hot months of summer. The tests were not sufficiently varied, as to place and time, to warrant definite deductions, but it may be said, in general terms, that these rivers, which in winter are paved with two

or three feet of ice, have in early August a general temperture of 76° to 77°: that the air in direct contact with the warm surface of the water has, in that month, its temperature raised to from 1° to 5° above that of the air directly above but in more exposed positions: and that this increase of temperature, which is greatest at the point of contact, is, at one foot above the surface of the water, already to a considerable extent lost.

On the Collection of Samples of Water for Bacteriological Analysis.

By Wyatt Johnston, M.D., Montreal.

I have been prompted to describe my method of collecting samples of water for bacteriological examination, in the hope of its being of service to those who are anxious to do field work in this department of bacteriology.

Certain principles govern this work which cannot be neglected without introducing serious sources of error. First, the bottles in which the samples are to be taken must be sterilized by a dry heat of 150° C. and afterwards kept out of the reach of contamination from outside sources (especially from dust) until the moment when the water is collected. To this end the mouths of the bottles must be kept from contact with the fingers, and the stopper is only to be removed in the water. Second, the manipulations must be rapid enough to permit of a large number of separate samples being collected, and finally, these should be taken from such points as will ensure their affording a fair index of the body of water under examination, as the number of bacteria in samples taken at different places from the same water often varies considerably.

The method usually adopted, that of immersing the bottle at arm's length and removing the stopper under water, though fraught with much personal discomfort in cold weather, is tolerably secure from contamination at the mouth of the bottle, but it has the disadvantage of only giving

the number of bacteria at the surface of the water. In the case of a rapidly flowing stream this is of little moment as the water is sure to be thoroughly mixed and the bacteria pretty evenly distributed. In standing bodies of water, such as lakes, ponds, reservoirs and wells, the bacteria for the most part sink to the bottom, so that the number of bacteria found at the surface affords no indication of their number in the deeper part, from which usually supply pipes are fed in the case of drinking waters.

In the course of a recent biological examination of the waters of the Ottawa and St. Lawrence rivers it was found necessary to take samples at some distance beneath the surface. In winter, when samples were obtained through a hole cut in ice, often from one to two feet in thickness, the water which welled up into the hole was found to be contaminated by the instruments used in cutting it. On one occasion the water in the ice hole yielded 8,000 colonies per c. cm., while a sample obtained from the running stream beneath the ice only gave 30. Lying beneath the solid ice running water there is often found a stratum of "*frazil*" ice. This consists of a dense mass of small, sharp ice fragments which have at one time been in contact with the bed of the stream and have then become contaminated from the soil. That water obtained from the midst of a bed of "*frazil*" ice is unsuitable for bacteriological examination was shown by one examination of St. Lawrence water made in mid-winter, when two samples from a bed of *frazil* yielded respectively 473 and 480 colonies per c. cm., while clear water from an adjacent spot gave only 77 and 39.

In endeavoring to obtain some apparatus suitable for obtaining deeper samples, I was surprised to find no mention of anything of the kind in any dealers' catalogues; their poverty in this particular contrasting strangely with the wealth of appliances available for other purposes.

It thus became necessary to procure some simple form of apparatus, secure from sources of extraneous contamination

and rapid enough in its working to enable me to obtain a large number of individual samples.

My first attempt was made with the assistance of Dr. R. F. Ruttan. We prepared a set of wide-mouthed bottles, fitted with perforated corks in which two open glass tubes were fitted. To one of the tubes a long rubber tube was attached, the end being guarded by a stop-cock. The bottles, with their glass tubes attached, were sterilized by dry heat and the rubber tubing was steamed separately for several hours. After sinking the bottle to the required depth by attaching a weight, upon opening the stopcock the water displaced the air in the bottle. The method seemed to give accurate results, and in each case a bit of the tubing reserved for the control test of washing it out with sterilized water yielded no bacteria colonies. The sterilization seemed to be perfect, but the method was abandoned as it was found too troublesome to sterilize a separate length of tubing for each sample that was to be taken.

I had obtained by this time some collecting bottles from Messrs. Eimer & Amend of New York. These were made of very heavy glass and held about a pint, the stoppers consisting of a rubber ring fitted round to a glass rod which lay within the bottle, and was so arranged that the stopper could be pulled up against the lower part of the neck from within by means of a wire attached to the glass rod.

In using this bottle one line was attached to the neck of the bottle and one to the wire fastened to the rod shaped stopper. The bottles were lowered by this second line, thus holding the stopper tightly against the neck of the bottles and so preventing the water from entering, until, at the desired depth the strain was taken off the stopper by pulling in the line attached to the neck of the bottle allowing it to fill, the stopper being heavy enough to fall from its own weight. This was open to the obvious objection that the neck of the bottle above the rod shaped stopper filled with water from the surface, most of which was afterwards naturally washed into the bottle. Besides

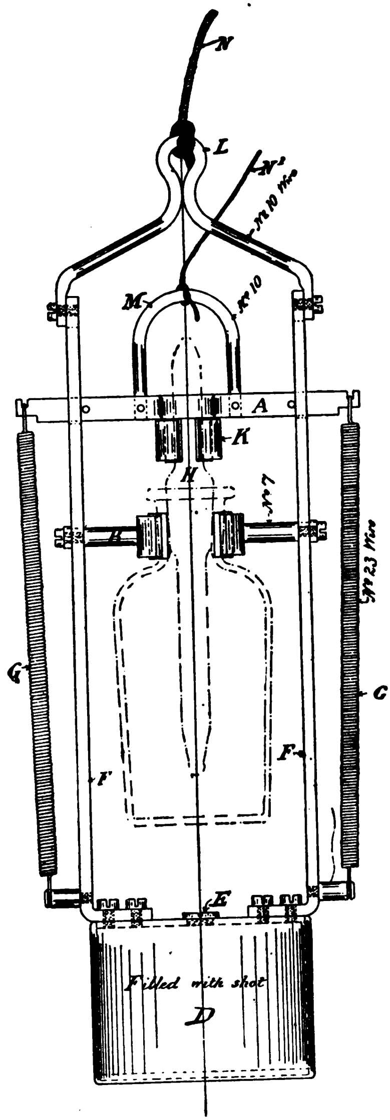
this the precautions necessary to guard against contamination of the wire while attaching the string, and the necessity of having a separate bottle for each sample collected, rendered them inconvenient for field use.

The method of using sealed tubes or flasks with a tapering end bent at right angles to be broken off under the water, has been recommended by Escherisch of Munich. This is much more free from technical sources of error than the apparatus last mentioned, but the trouble of preparing such flasks is considerable, as one has to be manufactured for every sample to be taken.

In the last edition of Rohrbeck's catalogue I find an apparatus figured for collecting bacteriological samples at different depths. From the impression conveyed by the illustration it seems too complicated to be easily handled, and the entire apparatus evidently requires to be re-sterilized before a second sample can be taken.

At this stage my attention was directed to a most ingenious apparatus invented by Prof. Ellis of Toronto University, which differed from all the others in principle. This was a device by which sterile glass stoppered bottles could be placed in a weighted frame and lowered to the required depth. By pulling a string the stopper could then be raised sufficiently to allow the water to enter. By releasing this end the stopper was instantly replaced by means of a spring. Any number of samples could be taken, as the bottles could be placed in the frame one after another with very little loss of time. The advantages of this as compared with the plans described above are very great. There is absolute certainty that no water is obtained from any except the required depth. There is no limit to the number of samples which can be taken, and all the preparation necessary is limited to sterilizing the bottles. It is also far more economical, as a single sinking frame contains in itself the attachments for opening and closing the bottles.

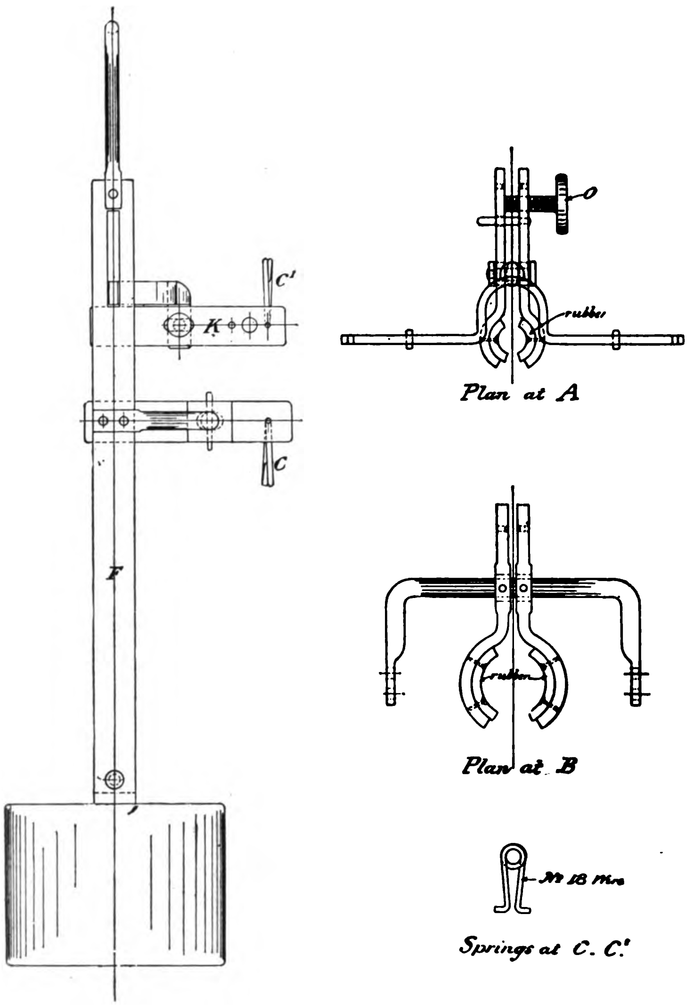
The instrument I am about to describe is a modification of that devised by Prof. Ellis, and I can claim no originality whatever with regard to the principle of opening



Dr. Wyatt Johnston's apparatus for

I

Plate III.



s of Water for Bacteriological Analysis.

ear).

and closing glass stoppered bottles under water. My apparatus, though a modification of Prof. Ellis', contains improvements of my own which render it specially adapted to taking large numbers of samples by making it simpler in construction and more rapid and accurate in action. All who have worked at water analysis know the great importance of making a very large number of separate observations before drawing conclusions.

My outfit consists of one collecting frame, shown (reduced to one-half its linear dimensions) in Plate III., into which the bottles can be successively fitted. It was made under my direction by Mr. O. Wendell, of 170 Coursol Street, Montreal, and cost about eight dollars. It may be briefly described as a sinking frame, to which the bottle is attached by a fixed clamp, while a movable clamp is used to raise and lower the stopper.

The frame is made of brass and has for its base a hollow cylindrical box D, 2½ inches deep and 2 inches in diameter. The box contains two pounds of shot and can be filled at a small hole E, which is closed by a screw. Attached to the top of this box are two flat brass bars F F, in the upper part of which a slot is cut allowing the movable cross bar A sufficient vertical play (1 inch) to admit of the bottle being opened beneath the water.

The neck of the bottle is grasped at B by a brass clamp, the jaws of which are lined with soft rubber, fastened on by rivets. These jaws work on pivots and are attached to the upright bars F. F. by means of a brass rod bent outward so as to bring the neck of the bottle into the line of traction. The pivots allow some lateral play. The clamp is kept closed upon the neck of the bottle by a brass spring C made of No. 18 wire.

The stopper H of the bottle is in the form of a tapering glass rod which is grasped by another clamp K and kept closed by the brass spring C. This clamp is secured to the sliding cross bar A by a horizontal pin working in slots which allow of sufficient backward and forward play to permit the stopper to adjust itself to the bottle. At the point

where the pin is fastened the cross bar is bent outwards to bring the jaws of the clamps into the line of traction. The shoulder thus formed bears the entire strain in opening and closing the bottle as both ends of the clamp are balanced beneath it. It will be seen that these attachments are not rigid, thus preventing any straining or jamming of the stopper.

A loop of heavy brass wire L connects the two side bars F. F. above and another loop M is attached to the cross bar A. To these loops strings are attached enabling apparatus to be worked under water.

A pair of spiral springs G. G. made of No. 23 wire are hooked over the ends of the cross bar A above and fastened to the foot of the upright bar below. They close the bottle when it has been opened and keep it closed at other times. To place a bottle in the frame the ends of the clamps C and C are compressed between the thumb and forefinger sufficiently to open the jaws. The frame, with bottle in position, is then lowered by means of a heavy string N attached to the loop L, when the desired depth is reached the stopper is raised by pulling a lighter string N, attached to the cross bar loop O. On releasing this again the springs close the bottle. The movement of raising the stopper can easily be felt at a depth of 15 or 20 feet.

The bottle fills in about 20 to 30 seconds and the bubbles of displaced air can usually be seen. It is better not to fill the bottles quite full, but to leave some space for subsequent shaking.

In very swift currents or when the sample is to be taken at a greater depth than 30 feet an additional weight in the form of a small bag of shot may be tied to the lower part of the frame.

To prevent any tendency of this frame to rotate while being lowered in a current, and thereby tangle the strings, I allow one string to glide in each side of my forefinger or else hold one in each hand.

Before placing a bottle in the frame it is well to ascertain

that the stopper is not jammed in the neck of the bottle from unequal expansion in the hot air sterilizer.

In working at considerable depths I have found it convenient to use a screw at O. This increased pressure upon the wings of the clamps holds the stopper more firmly. At other times the screw is not needed. By substituting a wire for the string attached to the cross bar, the opening and shutting can be readily controlled at very great depth.

A bottle is removed by simply compressing the wings of the clamps and lifting it out from the jaws. The ease and rapidity with which the apparatus works will be understood from the fact that I am able to collect 10 separate samples of water at a depth of 20 feet in from 10 to 15 minutes.

The bottles made use of are those dropping bottles fitted with ground glass pipettes now in common use for holding histological reagents. Both ends of the pipettes are sealed up in a gas flame, thus converting them practically into glass rods. As these bottles are kept in stock in the laboratory, one can always be replaced if it happens to be broken. The ones I employ hold 50 c. cm., but I would have preferred 100 c. cm. bottles had they been obtainable. The method of clasping the bottle by the neck admits of various sizes being employed in the same frame as there is space to spare between the cross bars.

The differences between the model here described and the original form introduced by Dr. Ellis are that the bottle is grasped by the neck instead of being forced into a socket from above. The use of spring clamps to hold the bottle, enables bottle and stopper to be brought into position by a single act instead of taking them apart and putting them in separately. The chief advantage of using the dropping bottles described lies in its giving a long tapering stopper, the lower end of which remains in the neck of the bottle when open, and guides it back into position, and it seemed preferable to use a bottle readily obtainable rather than to order a special form, which could not be replaced if broken.

The little sinking frame I have just described was ori-

ginally designed to enable a sample to be collected at any required depth with the same safety and precision as at the surface, but as it also fulfils all the precautions for collecting samples in general and saves one the necessity of repeatedly plunging one's arm into the water, I employ it whenever a sample is to be collected from an open body of water. In securing samples by hand from a stream I was previously under the necessity of either securing the services of a boat or else taking the sample from off the bank, with the great chance that in the latter case the shallow water near the shore might not be typical of the general body of the stream. But from this apparatus, which can be lowered into the water from a bridge, or by a rod, much more uniform results are obtained.

As the apparatus left little to be desired, as far as regards the rapidity and safety with which the act of collecting is performed, it only remained necessary to ensure the necks of the bottles against contamination previous to using them. Instead of using sterilized rubber caps for each bottle, a constant source of trouble and annoyance, I had a tin box made which holds forty bottles at once, each kept in position by cross partitions of tin. The bottles are numbered serially, before sterilizing, by writing in pencil upon the ground glass of the stopper, and by noting where each bottle is used the use of labels is unnecessary. Instead of a simple lid, the cover of the box is a tray four inches deep, in which a lump of ice is placed in warm weather. A small tube at one of the corners of this tray conducts the water away as fast as the ice melts. I find this keeps the temperature within the box below 8° C., even in the hottest weather. A handle across the tray serves to carry the box, and a small padlock in front guards it against an ever too inquisitive public.

Though I have not yet had cause to use it for this purpose, I think that my box, with its lump of ice on top, would form a better means of sending samples of water by express than any I have seen recommended. The temperature is kept down to a point where no increase of the

bacteria can go on, and the ice could be replenished by the officials from time to time, while the padlock or a seal would prevent its being tampered with. The space occupied by this box (18″×11″×8″) admits of its being placed in a large hot-air sterilizer and heated together with its contents to 150° C. A small piece of fine string placed in the neck of each bottle permitted the escape of any moisture, so that it is unnecessary to dry the bottles thoroughly before heating them. As the box is quite dust-tight the necks of the bottles remain sterile until the time comes to use them, doing away entirely with the employment of rubber caps.

In some cases when it seemed of interest to examine great stretches of water I took my samples from off the bow of a passenger steamboat in a very simple manner. By using a stout fishing rod and about twelve feet of line a sample can be secured well outside the " wash " of the boat, even at a speed of 12 to 15 miles per hour. To ensure the bottle sinking I wrapped a piece of sheet lead round it. By making the cast well ahead the bottle usually sank 6 to 8 feet.

As these examinations were always made in duplicate the accidental encounter of any extraneous source of pollution would infallibly have been shown by an abnomal excess of growth in one of the two samples. A striking proof of the delicacy of the method is that the duplicate samples always gave practically the same number of colonies. This "fishing" was often found a convenient method of obtaining a sample from the banks of a stream.

To ensure the accuracy of the result in estimating the number of bacteria in a water it is of great importance to curtail to a minimum the time which elapses between the collection of the sample and the plating of the cultures, to guard against a possible increase of bacteria in the interval. It is also advisable to make the cultures in some flat vessel which permits of their being counted from time to time without exposing the gelatine to the danger of receiving

additional bacteria from the air. Both of these objects are met by the flattened glass flasks designed by Petruschky.

These flasks contain the nutrient gelatine ready for use, so that it is only necessary to warm them gently and so melt the gelatine, drop in the proper amount of water and after shaking them gently to lay them on their side till the gelatine stiffens.

As these flasks are expensive and not always easy to obtain, it may be of interest to those who work under conditions which make it difficult to obtain apparatus to know that I have found ordinary flat sided, common, white glass vials, obtainable anywhere, answered the purpose admirably. Owing to the small size of the bottle necks I find it best to plug them by wrapping the cotton wool about the end of a wooden toothpick, which is then broken off short. By doing this the plug can be readily inserted and removed. The colonies are readily counted with a lens, and to facilitate this I rule with a writing diamond a couple of parallel scratches on the flat side of the bottle in the axis. Cross lines are not usually necessary. Any of the colonies can be fished out with as much ease as from a Petruschky flask. The only respect in which these bottles are not satisfactory is that, being made of rather thick glass, when using a low power microscope, the object appears somewhat blurred. This also could probably be obviated by using a correcting lens. They possess, however, a distinct advantage over the Petruschky flasks in being much stronger. They also pack closer, owing to their flat sides, and having flattened bottoms they can be stood up.

For summer field work I was able to pack 160 of the bottles in a small double walled tin chest or portable refrigerator, measuring 20″ × 16″ × 18″, and this included a space of 8″ × 8″ × 18″ for the ice chamber.

On The Cherts and Dolomites of The Animikie Rocks of Thunder Bay, Lake Superior.

By Elfric Drew Ingall, Ottawa, Ont.

A number of interesting features are presented by the rocks under consideration, but before dealing with their nature and structure it will be necessary to give a short explanation of their mode of occurrence for the benefit of those unfamiliar with the formation.

The Animikie or silver bearing rocks of Lake Superior occur in the vicinity of Thunder Bay. Starting from the small exposure of these rocks at the end of the peninsula between Thunder and Black Bays they form a narrow fringe along the western and northern shores of the former which connects with the main area of these rocks extending W. S. W. from Port Arthur. This area constitutes a belt from twenty to twenty-five miles wide, abutting on the west shores of Thunder Bay between Pigeon River and a point about eight miles east of Port Arthur and extending in a W. S. W. direction across the international boundary into the State of Minnesota. Along the northern fringe of the formation the rocks are found lying on the smooth surface of the Archean rocks, while in a southern direction they pass beneath the traps and conglomerates of the Keweenawan, famous for its native copper mines. The dip of the whole is at a very low angle to the S. S. E.

The Animikie formation is made up of traps, argillites and shales, cherts and dolomitic rocks. The traps present themselves as sheets at various horizons in the formation, and as more or less vertical dykes cutting the sedimentary rocks. The dykes can often be seen to connect with the sheets. In many places the sheets present unmistakeable evidence of having been intruded between the bedding planes of the sedimentary rocks showing flat under and curved upper surfaces. The stratification of the enclosing rocks being curved upwares comformably to the latter. Mr. W. S. Bailey of the Johns Hopkins University, Baltimore, U. S. A., who examined a number of thin sections of these

rocks microscopically describes them as more or less altered diabases.

The sedimentary rocks may be considered under two divisions; the upper in which the argillites and shales largely preponderate, and the lower consisting almost entirely of cherts and other siliceous rocks. In both of these divisions, between which no sharp line of demarcation exists, developments of calcareous and dolomitic areas are not unfrequent. A characteristic of the upper division rocks consists in their generally carbonaceous character and the dark colour resulting therefrom.

The cherty rocks of the lower division present many interesting features. In general appearance they are extremely varied both in colour and grain, opaque browns and reds being the colours most usually presented. Milky whites and dark black also occur, and dark greens have been met with, which, when speckled with bright red spots constitute a very ornamental stone.

In grain they vary between a compact flinty presentation with conchoidal fracture, in which no trace of their original nature can be seen by the unaided eye, to distinct sandstones whose fragmental nature is plainly brought out on weathered surfaces, the grains having been weathered out leaving a projecting reticulation of harder, less alterable material. The sandy grains are rounded and measure from 0·05 inch in diameter and less. At times the above described feature is reversed. The cementing material originally surrounding the grain, apparently an earthy carbonate, is seen to have been removed by weathering, leaving the grains standing out.

Brown oxides form a very constant constituent of all these rocks, to which is doubtless due their generally red and sometimes rusty appearance. This material also occurs in the form of magnetite to such an extent at places as to almost rank the beds as iron ores. Two specimens of this variety were analysed in the laboratory of the Geological Survey, and gave respectively 39·74 per cent. and 45·57

per cent. of metallic iron, titanium being absent.[1] The specimens were found to exhibit magnetic polarity in different degrees, this characteristic being also brought to light during the field surveys by the great local derangements of the magnetic needle. Small particles of pyrite are also frequently disseminated throughout these rocks.

An interesting variety is the "pitted chert." A considerable exposure will often be found pitted all over with little rounded cavities about the size of a pea. These present a rough and *hackly* inner surface, and are frequently partially filled with iron-rust. A variation of the phenomenon is presented in the occasional presence in the thin cherty layers, sometimes found interbedded in the argillites, of tubules at right angles to the surface of the layer, which, apart from the difference in shape, present much the same details of appearance as the cavities of the pitted cherts. Dr. Bell, in his report on this district, notices a very similar phenomenon. He says: "Nearly horizontal calcareous beds occur containing small coral-like siliceous concretions and vertical cylinders of chalcedony, transverse sections of which shew fine concentric rings resembling agate."[2]

Whilst calcareous matter is specially the characteristic of the upper argillites and shales, it is not entirely absent from the rocks under consideration, being present as a mineral resembling anthracite often found in the centre of vuggy cavities in the rocks.

In both upper and lower divisions calcareous and dolomitic areas are frequent, although not constituting a preponderating feature of the formation. In the argillaceous division the earthy carbonates are frequently present to such an extent as to give free effervescence with acid. In the lower siliceous division areas are frequent, made up of this calcareous and dolomitic material, which is often ferruginous, as shewn by the rusty appearances of weathered surfaces. At one place a fine-grained, grey dolomite was found to contain what appeared to be rounded pebbles of a

[1] Annual Rept. Geol. Surv. of Canada, Vol. III, p. 25 T.
[2] Report of Progress, Geological Survey of Canada, 1866-69, p. 324.

still finer grained black material, the latter standing out on weathered surfaces. Both these constituents, however, were found to be carbonates, differing only in the relative freedom of their effervescence with acids. Included in these calcareous portions there will also be seen at places nodules and inclusions of chert standing out on weathered surfaces and presenting hackly exterior surfaces. One specimen collected shewed, in a calcareous base, angular fragments of black chert, which had apparently been portions of continuous cherty layers, some cause having subsequently effected their fracture.

Before leaving the consideration of the macroscopic character of these rocks it should be stated that, whilst the variation of their characteristics is endless, the different varieties are not confined to any definite horizon in the subdivision to which they belong, and in a short distance in the same bed what will at one place be a typical flinty chert may be found to become granular or, by increasing preponderance of the earthy carbonates, to merge into a calcareous or dolomitic rock. Neither is the demarcation between the upper and lower divisions of the formation sharp, the delimitation being based upon the great preponderance of the argillaceous members in the former as contrasted with the essentially siliceous constitution of the latter. In fact, very siliceous or dolomitic portions are often found in the argillites, whilst beds of dark argillite and shale have been found amongst the lower cherty series.

Here then we have a number of rocks very dissimilar in nature, yet apparently forming interchangeable members of the series and at places merging one into the other. That they are much altered from their original condition is evident, and that they still occupy their original position as deposited, precludes the idea of any dynamic metamorphism nor do they show any signs of such action in other respects. The argillites show nothing but ordinary rock jointing apart from the bedding planes, no trace of slaty cleavage being present.

Their present condition would seem to be due to a quietly

proceeding process of chemical alteration and substitution in place, producing all the varieties of product according to the original mineral composition of the material and the extent to which the process has progressed. The original condition of the rocks would seem to have been that of a series of sands and clays laid down in the basin of deposition in the order of their coarseness. The sands would naturally preponderate in the areas of shallower water, becoming gradually mixed and interspersed with clayey matter, and the latter entirely replacing the former in passing towards the areas of greater depth.

The percolation of chemical waters subsequent to the elevation of the area and the compacting of the rocks would then produce all the varied phenomena noticed. The sandy parts being easily permeable would be most changed, whilst the impermeable clays would be left in their original condition, and the sandy clays would form an intermediate product.

The original grains of the sands having a very varying composition, would by their decomposition afford all the different materials at present constituting the rocks, the ferruginous elements being supplied where basic silicates constituted the grains.

The examination of these rocks by the microscopic method further reveals the nature and extent of the process of alteration above outlined, the following descriptions of three thin sections by Mr. W. S. Bailey [1] giving a very good idea of the most noticeable characteristics.

"No. 281. R. 64. LOCATION (*Chert*).—This rock is composed in greater part of what were originally round and irregular pieces of felspar, in a ground mass of quartz. The felspar has for the most part been entirely replaced by its various decomposition products, viz., calcite, chlorite and hydrated iron oxides. That portion which has not undergone this alteration has been completely replaced by silica; so that round, cloudy areas of silica (principally in the form of chalcedony) now appear where originally

[1] **Annual Reports Geological Survey, Vol. III. pp. 120 H. and 122 H.**

felspar existed. These pseudomorphs are usually marked by a rim of green or red color, probably due to chlorite and iron oxide, which separated out either previous to or coincident with the silicification process. Immediately outside of these rims there is deposition of chalcedony, which forms a feathery periphery extending from all sides into the interstices between large quartz grains, which in turn form a mosaic in the centre of the spaces between the original grains of felspar.

"Scattered through the slide, both in the larger grains and also in the interstices between these, are little cloudy, almost opaque, areas, which under crossed nicols, resolve themselves into calcite. The centres of these little areas are dark and structureless, while the outer portions are composed of the perfectly crystallized mineral. This calcite has every appearance of having been enlarged, after it had once been formed, by the addition of new material around the opaque portions in a manner analogous to the enlargements of quartz grains, so distinctly shown by Profs. Irving and Van Hise, of the United States Geological Survey.

"The present condition of the rock seems to be due to a very thorough process of silicification.

"No. 303. Silver Bluff, (R. 61).—(*About fifty feet below contact.*) Is of the same general nature as the above. In this, however, the calcite occurs with chlorite and other alteration products of felspar to form complete pseudomorphs of this mineral. Round and angular grains consist now of chlorite and crystallized calcite, mixed with magnetite (which is usually found around the edges of the grain), and a brown earthy substance. The outlines of the original grains are well preserved by the rim of magnetite, but their material has entirely disappeared. From the large amount of magnetite and other iron minerals present in the slide it may be doubted whether the original grains were not augite or some other iron-bearing mineral.

"A few grains are composed entirely of silica, as in the case of section 281.

"No. 325. R. 93 RIDGE.—(*Overlying cherty beds.*)—Is not very different from 303, except in the alteration of the rounded grains. In many cases, these consist of a very dark reddish-brown micaceous substance, mingled with a green mineral (probably of the serpentine group) and reddish-brown iron hydroxide. In some of the lighter colored grains, the remains of a colorless augite can readily be detected.

"In other cases, the entire substance of the original grain has given place to silica in the form of a fine mosaic of quartz. In these, the outline of the original grain has been rendered permanent by a line of little plates of brown mica.

"As in 303, the interstitial substance is quartz. Around the edges of the separate grains, crystals of quartz extend out on all sides, like the lining of a vein. Where the space between the fragmental grains was small, the two rows of quartz crystals mutually interfere and completely fill the spaces; where the intervening space was large, that portion in its centre between the rows of crystals is filled by a mosaic of the same mineral. Cracks which extend through the rock contain iron oxides or hydroxides."

A number of other sections examined by the writer presented in a general way the same characteristics as those above described. All without exception shewed the feathery periphry of quartz crystals, with the mosaic of larger individuals in the larger spaces. The highly ferruginous varieties, shewing magnetic polarity, were seen to be very largely composed of magnetite, generally disposed around the rim of the particles, the central parts being mostly composed of a finely crystallized quartz mass. Many particles, however, seem to be almost wholly made up of the iron minerals. By reflected light the ferruginous areas gave, in places, a dark red colour, shewing the alteration of the magnetic into ferric oxide. Although not a frequent phenomenon, the magnetite was occasionally seen to be deposited in the interstitial quartz areas. In these cases the mineral would be found to fill the centre of the space, its outlines conforming to those of the surrounding grains,

transparent slides interveining to separate the two. In reflected light, too, pyrite is seen to be a not infrequent constituent.

In another section the original shape of the grains is outlined by iron hydroxide, and they have a peculiar frayed out edge, the brown material also forming a faint demarcation of the outlines of the large quartz crystals composing the interstitial mosaic.

Whilst the grains are generally rounded, there is a certain proportion of sub-angular fragments, but these would seem to result from the disintegration of the original rounded particles during the process of decomposition and solution, and often where the grain retains its primary shape numerous fissures are seen to penetrate towards its centre, which are filled with crystallized quartz similar to that surrounding it and present an incipient stage of the breaking-up process.

The mergence from the distinctly grained varieties into the compact cherts will be frequently illustrated in the same hard specimen, and examination of a thin section from such a one clearly shews the nature of the process to which the effect is due. Viewed in ordinary light, a portion of such a slide will shew distinctly marked grains with transparent quartz surrounding them. Passing towards the other edge of the section, representing the compact cherty part of the original specimens, the grains are found to shew less and less distinctly, until a portion is reached consisting apparently of nothing but transparent quartz, somewhat clouded in places, and with a few distributed areas of magnetite and iron hydroxide. An examination under polarized light, however, brings out the original structure by the contrast between the fine crystallization of the quartz replacing the original grain and that interstitially deposited.

Occasionally specimens of a pretty wavily marked variety of the cherts will be found. A section of such a one shows it to be similar in nature to the rest, except for the general parallel appearance produced by the drawing out of its constituents. The mass of the section is made up of a

clouded crystalline quartz, with much red earthy material, probably iron hydroxide, which, being drawn out into long streaks, constitutes the wavy marking of the stone. The few particles left are also considerably drawn out and seem to be congregated at the apices of the bends. They are outlined by material similar to that constituting the streaks, which would appear to be long drawn out grains. Such evidences of dynamic action are, however, quite local and at some places would seem to be connected with the presence of the trap sheets and might be therefore due to the force of their intrusion.

The general appearance of these rocks under the microscope would seem to indicate that the secondary minerals at present constituting their bulk were not only supplied from the original materials of the grains, but deposited close to and around the points from which derived, long soaking in the percolating mineral waters producing all the different varieties of these rocks at present found. The extent to which the process has gone doubtless depended largely on the original constitution of the particles acted upon. These would seem mineralogically to have been largely made up of felspathic material accompanied in places by more basic silicates and just such as might have been derived from the disintegration of the Archean rocks upon whose water smoothed surface they rest. The great irregularity and indefiniteness of the distribution of the calcareous and dolomitic portions throughout the formation would also be accounted for on this supposition, and light would be thrown upon the formation of the curious spherical "bombs" which occur so frequently in the upper argillaceous division. In many places there will be seen to occur lenticules in the argillites around which the bedding is seen to bend conformably to their outline. Several specimens examined were found to effervesce more or less freely with acid, and the impression left after the study of a number of cases was that a process of dolomitization of the rock had gone on in spots, segregation of the earthy carbonates around a centre accounting for the more or less

spherical shape, the bending of the surrounding stratification being due to the crystallising force. All gradations of this process could be seen from the simple lenticular thickening of a particular layer to the development of a complete spherical "bomb."

The results of the microscopic studies as given above would thus seem to give a satisfactory explanation of the at first sight so curious association of argillites, dolomites and cherts, and also furnish an interesting example of the considerable alteration of a series of rocks by chemical action alone unaccompanied by any of the more powerful forces usually resorted to in explanation of the metamorphism of rocks.

Supplemental Notes on the Flora of Cap-a-L'Aigle.

By Robert Campbell, M.A., D.D.

In the Record of Science, Vol. IV., No. 1, pp. 54–68, appeared a catalogue of the plants found up to that date, during the months of July and August, in successive years. The following species were discovered in the same district in the summer of 1891:—

Exogens.

Caryophyllaceæ:

Arenaria peploides, L., Port au Persil, near the shore.

Malvaceæ:

Malva crispa, L., in two places, apparently escaped from gardens.

Hypericaceæ:

Hypericum ellipticum, Hook., on the banks of the Trou River.

Hypericum canadense, L., near the Loutre River.

Leguminosæ:

Trifolium hybridum, L., near the River Port au Salmon.

Trifolium agrarium, L., in the same locality as above.

Vicia caroliniana, Watt., near the cemetery, banks of Murray River.

ROSACEÆ:

Prunus virginiana, L., road to the Trou.

Genus strictum, Ait., everywhere (omitted accidentally from former catalogue).

Potentilla pennsylvanica, L., near Ste. Fidele.

Cratœgus tomentosa, L., road to Loutre.

SAXIFRAGACEÆ:

Mitella nuda, L., east bank of the Loutre.

UMBELLIFERÆ

Osmorrhiza longistylis, D. C., woods on high ridge near Cap-a-l'Aigle wharf.

COMPOSITÆ.

Solidago virga-aurea, L., banks of a mountain stream.

Solidago ohioensis, Riddell, woods near Fraser Falls.

Solidago nemoralis, Ait., in the same locality as above.

Aster puniceus, L., near the Trou.

Aster ptarmicoides, Torr. and Gray, at the Upper Fraser Falls.

Ambrosia artemisiœfolia L., in one spot, come in within two years.

Bidens frondosa, L., on road to Port au Persil.

Hieracium marianum, var. *Spathulatum*, Gray, two specimens on Perrault's Hill.

ERICACEÆ:

Vaccinium canadense, Fraser River Road.

Chimaphila umbellata, Nutt., woody heights near Loutre.

Moneses grandiflora, Salis., one specimen near Port au Salmon River.

PRIMULACEÆ:

Glaux maritima, L., sandy shore near mouth of Murray River.

BORRAGINACEÆ:

Mertensia maritima, Don., in same situation as last above.

SCROPHULARIACEÆ:

Pedicularis palustris, L., marsh near mouth of Murray River.

LABIATÆ:

Lycopus virginicus, L., above Ste. Fidele village.

POLYGONACEÆ:

Polygonum lapathifolium, var. *incarnatum*, Watson, near Loutre.

ELÆAGNACEÆ:

Shepherdia canadensis, Nutt., two specimens about half a mile apart, near Cap-a-l'Aigle P. O.

ENDOGENS.

ORCHIDACEÆ:

Microstylis ophioglossoides, Nutt., near Cap-à-l'Aigle P. O. and at the Trou.

Habenaria hyperborea, R. Br., mouth of Murray River.

ALISMACEÆ:

Alisma plantago, L., mouth of Murray River.

GRAMINEÆ:

Elymus canadensis, L., beyond the Loutre.

FILICES:

Osmunda claytoniana, L., in great abundance beyond the Loutre.

Osmunda cinnamomea, L., in the same localities as above.

OPHIOGLOSSACEÆ:

Botrychium virginianum, Swartz., one specimen near Upper Fraser Falls.

Three mistakes were inadvertently made in the former catalogue:—

Physalis viscosa should have read *Physalis grandiflora*.

Euphorbia platyphylla should have read *Euphorbia helioscopia*.

Arundinaria macrosperma should have read *Cinna arundinacea*, var. *pendula*.

A List of Coleoptera Collected in the Vicinity of St. Jérome, Que.

By J. F. Hausen.

CICINDELIDÆ.

Cicindela, Linn.

1. *longilabris*, Say.
2. *6-guttata*, Fab.
3. *purpurea*, Oliv.
4. *vulgaris*, Say.
5. *repanda*, Dej.
6. 12-*guttata*, Dej.

CARABIDÆ.

Carabus, Linn.

7. *serratus*, Say.

Calosoma, Web.

8. *frigidum*, Kirby.
9. *calidum*, Fab.

Elaphrus, Fab.

10. *riparius*, Linn.
11. *ruscarius*, Say.

Bembidium, Lat.

12. *carinulum*, Chd.
13. *inæquale*, Say.
14. *chalceum*, Dej.
15. *concolor*, Kirby.
16. *lucidum*, Lec.
17. *variegatum*, Say.
18. *versicolor*, Lec.
19. *quadrimaculatum*, Linn.

Pterostichus, Bon.

20. *adoxus*, Say.
21. *honestus*, Say.
22. *lachrymosus*, Newm.
23. *coracinus*, Newm.
24. *stygicus*, Say.
25. *lucublandus*, Say.
26. *caudicalis*, Say.
27. *luctuosus*, Dej.
28. *corvinus*, Dej.
29. *mutus*, Say.
30. *orinomum*, Leach.
31. *desidiosus*, Lec.

Amara, Bon.

32. *exarata*, Dej.
33. *angustata*, Say.
34. *impuncticollis*, Say.
35. *fallax*, Lec.
36. *interstitialis*, Dej.
37. *obesa*, Say.

Diplochila, Brullé

38. *laticollis*, Lec.

BADISTER, Clairv.

39. *pulchellus*, Lec.

CALATHUS, Bon.

40. *gregarius*, Say.

PLATYNUS, Bon.

41. *brunneomarginatus*, Mann.
42. *extensicollis*, Say.
43. *pusillus*, Lec.
44. *errans*, Say.
45. *melanarius*, Dej.
46. *affinis*, Kirby.
47. *metallescens*, Lec.
48. *cupripennis*, Say.
49. *placidus*, Say.
50. *obsoletus*, Say.

LEBIA, Lat.

51. *viridis*, Say.
52. *pumila*, Dej.

CYMINDIS, Lat.

53. *cribricollis*, Dej.
54. *borealis*, Lec.

BRACHYNUS, Web.

55. *fumans*, Fab.
56. *cordicollis*, Dej.

CHLÆNIUS, Bon.

57. *sericeus*, Forst.
58. *leucoscelis*, Chev.
59. *tricolor*. Dej.
60. *pennsylvanicus*, Say.
61. *impunctifrons*, Say.
62. *tomentosus*, Say.

ANOMOGLOSSUS, Chd.

63. *emarginatus*, Say.

BRACHYLOBUS, Chd.

64. *lithophilus*, Say.

AGONODERUS, Dej.

65. *lineola*, Fab.
66. *pallipes*, Fab.

HARPALUS, Lat.

67. *viridiæneus*, Beauv.
68. *caliginosus*, Fab.
69. *pennsylvanicus*, De G.
70. *herbivagus*, Say.
71. *clandestinus*, Lec. (?)

STENOLOPHUS, Dej.

72. *fuliginosus*, Dej.
73. *conjunctus*, Say.

BRADYCELLUS, Er.

74. *cognatus*, Gyll.
75. *rupestris*, Say.

ANISODACTYLUS, Dej.

76. *rusticus*, Dej.
77. *agricola*, Say.
78. *discoideus*, Dej.
79. *baltimorensis*, Say.

HALIPLIDÆ.

HALIPLUS, Lat.

80. *triopsis*, Aubé.

CNEMIDOTUS, Er.

81. 12—*punctatus*, Say.

DYTISCIDÆ.

LACCOPHILUS, Leach.

82. *masculosus*, Germ.

ILBIUS, Er.

83. *biguttalus*, Germ.

COPTOTOMUS, Say.

84. *interrogatus*, Fab.

AGABUS, Leach.

85. *obtusatus*, Say.

COLYMBETES, Clairv.

86. *sculptilis*, Harr.

DYTISCUS, Linn.

87. *fasciventris*, Say.
88. *sublimbatus*, Lec.
89. *Harrisii*, Kirby.

ACILIUS, Leach.

90. *fraternus*, Harr.

GYRINIDÆ.

GYRINUS, Linn.

91. *ventralis*, Kirby.

DINEUTES, MacL.

92. *discolor*, Aubé.

HYDROPHILIDÆ.

HELOPHORUS, Fab.

93. *lacustris*, Lec.
94. *tuberculatus*, Gyll.

HYDRÆNA, Kug.

95. *pennsylvanica*, Kies.

HYDROPHILUS, Geoff.

96. *triangularis*, Say.
97. *glaber*, Hbst.

HYDROCHARIS, Lat.

98. *obtusatus*, Say.

BEROSUS, Leach.

99. *peregrinus*, Hbst.
100. *striatus*, Say.

HYDROBIUS, Leach.

101. *globosus*, Say.
102 *fuscipes*, Linn.

CERCYON, Leach.

103. *unipunctatum*, Linn.
104. *posticatum*, Mann.

CRYPTOPLEURUM, Mul.

105. *vagans*, Lec.

SILPHIDÆ.

NECROPHORUS, Fab.

106. *orbicollis*, Say.
107. *marginatus*, Fab.
108. *vespilloides*, Hbst.
109. *tomentosus*, Web.

SILPHA, Linn.

110. *surinamensis*, Fab.
111. *lapponica*, Hbst.
112. *inæqualis*, Fab.
113. *noveboracensis*, Forst.
114. *americana*, Linn.

STAPHYLINIDÆ.

FALAGRIA, Mann.

115. *bilobata*, Say. (?)

HOMALOTA, Mann.

5 species undetermined.

ALEOCHARA, Grav.

121. *lata*, Grav.
122. *bimaculata*, Grav.

GYROPHÆNA. Mann.

123. *vinula*, Er.
124. *socia*, Er.

HETEROTHOPS, Steph.

125. *fumigatus*, Lec.

QUEDIUS, Steph.

126. *lævigatus*, Gyll.

LISTOTROPHUS, Perty.

127. *cingulatus*, Grav.

CREOPHILUS, Kirby.

128. *villosus*, Grav.

STAPHYLINUS, Linn.

129. *badipes*, Lec.
130. *cinnamopterus*, Grav.
131. *violaceus*, Grav.
132. *viridanus*, Fauvel.

OCYPUS, Kirby.

133. *ater*, Grav.

PHILONTHUS, Curt.

134. *æneus*, Rossi.
135 *lætulus*, Say.
136. *lomatus*, Er.
137. *blandus*, Grav.
138. *cyanipennis*, Fab.
139. *sordidus*, Grav.
140. *stictus*, Hausen.
141. *ventralis*, Grav.

XANTHOLINUS, Serv.

142. *cephalus*, Say.
143. *obsidianus*, Melsh.
144. *obscurus*, Er.
145. *hamatus*, Say.

BAPTOLINUS, Kraatz.

146. *macrocephalus*, Nord.

STENUS, Lat.

147. *femoratus*, Say.
148. *annularis*, Er.

CRYPTOBIUM, Mann.

149. *bicolor*, Grav.
150. *pallipes*, Grav.

LATHROBIUM, Grav.

151. *grande*, Lec.
152. *punctulatum*, Lec.
153. *nigrum*, Lec.
154. *dimidiatum*, Say.

SCOPÆUS, Er.

155. *exiguus*, Er.

LITHOCHARIS, Say.

156. *confluens*, Say.

PÆDERUS, Grav.

157. *littorarius*, Grav.

SUNIUS, Steph.

158. *longiusculis*, Mann.

TACHINUS, Grav.

159. *flavipennis*, Dej.
160. *luridus*, Er.
161. *canadensis*, Horn.
162. *fimbriatus*, Grav.

TACHYPARUS, Grav.

163. *jocosus*, Say.

ERCHOMUS, Mots.

164. *ventriculus*, Say.

CONOSOMA, Kraatz.

165. *crassum*, Grav.
166. *basale*, Er.

BOLETOBIUS, Leach.

167. *cincticollis*, Say.
168. *cinctus*, Grav.

OXYPORUS, Fab.

169. *stygicus*, Say.
170. *vittatus*, Grav.

PLATYSTETHUS, Mann.

171. *americanus*, Er.

OXYTELUS, Grav.

172. *sculptus*, Grav.

SCAPHIIDIDÆ.

SCAPHIDIUM, Oliv.

173. *quadriguttatum*, Say.

PHALACRIDÆ.

OLIBRUS, Er.

174. *pallipes*, Say.
175. *nitidus*, Melsh.

COCCINELLIDÆ.

ANISOSTICTA, Dup.

176. *strigata*, Thumb.

HIPPODAMIA, Muls.

177. 13—*punctata*. Linn.
178. *parenthesis*, Say.

COCCINELLA, Linn.

179. *trifasciata*, Linn.
180. 9—*notata*, Hbst.
181. *transversoguttata*, Fab.
182. *sanguinea*, Linn.

ADALIA, Muls.

183. *frigida*, Schn.
184. *bipunctata*, Linn.

HARMONIA. Muls.

185. *picta*, Rand.

ANATIS, Muls.

186. 15—*punctata*, Oliv. (= *canadensis*, Prov.)

PSYLLOBORA, Muls.

187. 20—*maculata*, Say.

CHILOCORUS, Leach.

188. *bivulnerus*, Muls.

BRACHYACANTHA, Chev.

189. *ursina*, Fab. 190. var. 10—*pustulata*, Melsh.

HYPERASPIS, Chev.

191. *signata*, Oliv.

SCYMNUS, Kug.

192. *caudalis*, Lec.

ENDOMYCHIDÆ.

PHYMAPHORA. Newm.

193. *pulchella*, Newm.

ENDOMYCHUS, Panz.

194. *biguttatus*, Say.

EROTYLIDÆ.

TRITOMA, Fab.

195. *thoracica*, Say.

CUCUJIDÆ.

SILVANUS, Lat.

196. *planatus*, Germ.

NAUSIBIUS, Redt.

197. *dentatus*, Marsh.

PEDIACUS, Shuck.

198. *fuscus*, Er.

LÆMOPHLÆUS, Lap.

199. *biguttatus*, Say. 200. *fasciatus*, Melsh.

BRONTES, Fab.

201. *dubuis*, Fab.

CRYPTOPHAGIDÆ.

ANTHEROPHAGUS, Lat.

202. *ochraceus*, Melsh.

CRYPTOPHAGUS, Hbst.

203. *cellaris*, Scop.

MYCETOPHAGIDÆ.

MYCETOPHAGUS, Hellw.

204. *punctatus*, Say.
205. *flexuosus*, Say.

DERMESTIDÆ.

BYTURUS, Lat.

206. *unicolor*, Say.

DERMESTES, Linn.

207. *lardarius*, Linn.

ATTAGENUS, Lat.

208 *megaloma*.
209. *pellio*, Linn.

ANTHRENUS, Fab.

210. *musæorum*, Linn.

ORPHILUS, Er.

211. *glabratus*, Fab.

HISTERIDÆ.

HISTER, LINN.

212. *interruptus*, Beauv.
213. *abbreviatus*, Fab.
214. *merdarius*, Hoffm.
215. *americanus*, Payk.

NITIDULIDÆ.

CERCUS, Lat.

216. *pennatus*, Murr.

CARPOPHILUS, Steph.

217. *niger*, Say.

COLASTUS, Er.

218. *truncatus*, Rand.

CONOTELUS, Er.

219. *obscurus*, Er.

EPURÆA, Er.

220. *rufa*, Say.
221. *avara*, Rand.

NITIDULA, Fab.

222. *bipustulata*, Linn.
223. *rufipes*, Linn.

STELIDOTA, Er.

224. 8—*maculata*, Say.

PROMETOPIA, Er.

225. *sexmaculata*, Say.

PHENOLIA, Fab.

226. *grossa*, Fab.

OMOSITA, Er.

227. *colon*, Linn.
228. *discoidea*, Linn.

CRYPTARCHA, Shuck.

229. *ampla*, Er.

IPS, Fab.

230. *fasciatus*, Oliv.
geminatus, Melsh.
231. *confluentus*, Say.
232. *sanguinolentus*, Oliv.

LATRIDIIDÆ.

CORTICARIA, Marsh.

233. *grossa*, Lec.
234. *pusilla*, Mann.
235. *cavicollis*, Mann.

TROGOSITIDÆ.

TENEBRIOIDES, Pall.

236. *intermedia*, Horn.
237. *dubia*, Harss.

PELTIS, Ill.

238. *ferruginea*, Linn.

GRYNOCHARIS, Thom.

239. *quadrilineata*, Melsh.

BYRRHIDÆ.

CYTILUS. Er.

240. *trivittatus*, Melsh.

BYRRHUS, Linos.

241. *americanus*, Lec.

PARNIDÆ.

DRYOPS, Oliv.

242. *fastigiatus*, Say.

HETEROCERUS, Fab.

243. *mollinus*, Kies.

DASCYLLIDÆ.

ANCHYTARSUS, Gecér.

244. *bicolor*, Melsh.

SCIRTES, Ill.

245. *titialis*, Guér.

CYPHON, Payk.

246. *variabilis*, Thunb.

ELATERIDÆ.

ADELOCERA, Lat.

247. *marmorata*, Fab.
248. *brevicornis*, Lec.

ALAUS, Esch.

249. *oculatus*, Linn.

CARDIOPHORUS, Esch.

250 *convexulus*, Lec.

CRYPTOHYPNUS, Esch.

251. *grandicollis*, Lec.
252. *abbreviatus*, Say.
253. *pectoralis*, Say.

MONOCREPIDIUS, Esch.

254. *auritus*, Hbst.

ELATER, Linn.

255. *nigricollis*, Hbst.
256. *linteus*, Say.
257. *semicinctus*, Rand.
258. *rubricus*, Say.
259. *apicatus*, Say.
260. *obliquus*, Say.

AGRIOTES, Esch.

261. *mancus*, Say.
262. *pubescens*, Melsh.

DOLOPIUS, Esch.

263. *lateralis*, Esch.

MELANOTUS, Esch.

264. *Leonardi*, Lec.
265. *fissilis*, Say.
266. *communis*, Gyll.

LIMONIUS, Esch.

267. *aurifer*, Lec.
268. *stigma*, Hbst.
269. *confusus*, Lec.
270. *quercinus*, Say.
271. *basillaris*, Say.
272. Sp. undetermined.

PITYOBIUS, Lec.

273. *anguinus*, Lec.

ATHOUS, Esch.

274. *Brightwelli*, Kby.
275. *rufifrons*, Rand.

ŒSTODES, Lec.

276. *tenuicollis*, Rand.

SERICOSOMUS, Steph.

277. *incongruus*, Lec.
278. *silaceus*, Say.

CORYMBITES, Lat.

279. *virens*, Schr.
280. *vernalis*, Hentz.
281. *cylindriformis*, Hbst.
282. *tarsalis*, Melsh.
283. *falsificus*, Lec.
284. *sulcicollis*, Say.
285. *hamatus*, Say.
286. *hieroglyphicus*, Say.
287. *cruciatus*, Linn.
288. *æripennis*, Kby.

ASAPHES, Kutz.

289. *decoloratus*, Say.
290. *memnonius*, Hbst.

BUPRESTIDÆ.

CALCOPHARA, Sol.

291. *virginiensis*, Drury

DICERCA, Esch.

292. *prolongata*, Lec.
203. *divaricata*.
294. *lurida*, Fab.
295. *tenebrosa*.

BUPRESTIS, Linn.

296. *lineata*, Fab.
297. *maculiventris*, Say.
298. *fasciata*, Fab.
299. *striata*, Fab.

MELANOPHILA, Esch.

300. *longipes*, Say.
301. *fulvoguttata*.

CHRYSOBOTHRIS, Esch.

302. *femorata*, Fab.
303. 4—*impressa*, Lap. & Gory.
304. *dentipes*, Germ.
305. *scabripennis*, Lap. & Gory.

EUPRISTOCERUS, Deyr.

306. *cogitans*, Web.

AGRILUS, Steph.

307. *arcuatus*, Say.
308. *ruficollis*, Fab.
309. *otiosus*, Say.
310. *torpidus*, Lec.
311. *egenus*, Gory.

BRACHYS, Sol.

312. *ovata*, Web.
313. *ærosa*, Melsh.

LAMPYRIDÆ.

CALOPTERON, Guér.

314. *terminale*, Say.

CELETES, Newm.

315. *basalis*, Lec.

EROS, Newm.

316. *aurora*, Hbst.
coccinatus, Say.
317. *humeralis*, Fab.

LUCIDOTA, Lap.

318. *atra*, Fab.

ELLYCHNIA, Lec.

319. *corrusca*, Lec.
320. var. *lacustris*, Melsh.

PYROPYA, Mots.

321. *nigricans*, Say.
322. *decipiens*, Harr.

PYRACTOMENA, Lec.

323. *angulata*, Say.

PHOTINUS, Lap.

324. *ardens*, Lec.
325. *scintillans*, Say.

PHOTURIS, Lec.

326. *pennsylvanica*, De G.

CHAULIOGNATHUS, Hentz.

327. *pennsylvanicus*, De G.

PODABRUS, Westw.

328. *tricostatus*, Say.
329. *rugulosus*, Lec.
330. *modestus*, Say.
331. *simplex*, Couper.

SILIS, Lat.

332. *percomis*, Say.

TELEPHORUS, Schäff.

333. *excavatus*, Lec.
334. *fraxini*, Say.
335. *carolinus*, Fab.
336. *tuberculatus*, Lec.
337. *bilineatus*, Say.

CLERIDÆ.

TRICHODES, Hbst.

338. *Nuttalli*, Kby.

CLERUS, Geoff.

339. *quadriguttatus*, Oliv.
340. *thoracicus*, Oliv.

THANASIMUS, Lat.

341. *dubius*, Fab.
342. *nubilus*, Kl.

THANEROCLERUS, Spin.

343. *sanguineus*, Say.

HYDNOCERA, Newm.

344. *cyanescens*, Lec.

NECROBIA, Lat.

345. *rufipes*, Fab.
346. *ruficollis*, Fab.
347. *violaceus*, Linn.

PTINIDÆ.

PTINUS, Linn.

348. *fur*, Linn.
349. *brunneus*, Duft.

EUCRADA, Lec.

350. *humeralis*, Melsh.

HADROBREGMUS, Thom.

351. *errans*, Melsh.

TRYPOPITYS, Redt.

352. *sericeus*, Say.

CIOIDÆ.

CIS, Lat.

353. *fuscipes*, Mellié.

ENNEARTHRON, Mellié.

254. *thoracicorne*.

LUCANIDÆ.

PLATYCERUS, Geoff.

355. *quercus*, Web.
356. *depressus*, Lec.

SCARABÆIDÆ.

ONTHOPHAGUS, Lat.

357. *Hecate*, Panz.

APHODIUS, Ill.

358. *fossor*, Linn.
359. *fimetarius*, Linn.
360. *ruricola*, Melsh.
361. *femoralis*, Say.
362. *granarius*, Linn.
363. *vittatus*, Say.
364. *inquinatus*, Hbst.

GEOTRUPES, Lat,

365. *splendidus*, Fab.
366. *Blackburnii*, Fab.

HOPLIA, Ill.

367. *trifasciata*, Say.

DICHELONYCHA, Kirby.

368. *elongata*, Fab.
369. *albicollis*, Burm.

SERICA, MacL.

370. *vespertina*, Gyll.
371. *sericea*, Ill.

LACHNOSTERA, Hope.

372. *fusca*, Fröh.
373. *hirticula*, Knock.

LIGYRUS, Burm.

374. *relictus*, Say.

OSMODERMA, Lep.

375. *eremicola*, Knoch.
376. *scabra*, Beauv.

TRICHIUS, Fab.

377. *affinis*, Gory.

SPONDYLIDÆ

PARANDRA, Lat.

378. *brunnea*, Fab.

CERAMBYCIDÆ.

ORTHOSOMA, Serv.

379. *brunneum*, Forst.

ASEMUM, Esch.

380. *atrum*, Esch.

CRIOCEPHALUS, Muls.

381. *agrestis*, Kirby.

TETROPIUM, Kirby.

382. *cinnamopterum*, Kirby.

GONOCALLUS, Lec.

383. *collaris*, Kirby.

RHOPALOPUS, Muls.

384. *sanguinicollis*, Horn.

HYLOTRUPES, Serv.

385. *ligneus*, Fab.

PHYMATODES, Muls.

386. *amœnus*, Say.
387. *dimidiatus*, Kirby.

CALLIDIUM, Fab.

388. *antennatum*, Newm.
389. *janthinum*, Lec.

ELAPHIDION, Serv.

390. *parallelum*, Newm.

MOLORCHUS, Fab.

391. *bimaculatus*, Say.

CYLLENE, Newm.

392. *robiniæ*, Forst.

PLAGIONOTUS, Muls.

393. *speciosus*, Say.

ARHOPALUS, Serv.

394. *fulminans*, Fab.

XYLOTRECHUS, Chev.

395. *colonus*, Fab.
396. *sagittatus*, Germ.
397. *undulatus*, Say.
398. var. *fuscus*, Kirby.

PLAGITHMYSUS, Motsch.

399. *muricatulus*, Kirby.

CLYTANTHUS, Thom.

400. *ruricola*, Oliv.

CYRTOPHORUS, Lec.

401. *verrucosus*, Oliv.

EUDERCES, Lec.

402. *picipes*, Fab.

DESMOCERUS, Serv.

403. *palliatus*, Forst.

RHAGIUM, Fab.

404. *lineatum*, Oliv.

PACHYTA, Serv.

405. *monticola*, Rand.
496. *rugipennis*, Newm.

ACMÆOPS, Lec.

407. *proteus*, Kirby.
408. *pratensis*, Laich.

GAUROTES, Lec.

409. *cyanipennis*, Say.

BELLAMIRA, Lec.

410. *scalaris*, Say.

TYPOCERUS, Lec.

411. *badius*, Newm.
412. *velutinus*, Oliv.
413. *sinuatus*, Newm.

LEPTURA, Serv.

414. *subhamata*, Rand.
415. *elegans*, Lec.
416. *capitata*, Newm.
417. *subargentata*, Kirby.
var. *ruficeps*, Lec.
418. *nigrella*, Say.
419. *canadensis*, Fab.
420. *vagans*, Oliv.
421. *chrysocoma*, Kirby.
422. *proxima*, Say.
423. *vittata*, Germ.
424. *pubera*, Say.
425. *ruficollis*, Say.
426. *mutabilis*, Newm.

PSENOCERUS, Lec.

427. *supernotatus*, Say.

MONOHAMMUS, Serv.

428. *scutellatus*, Say.
429. *confusor*, Kirby.
430. *marmorator*, Kirby.

HYPERPLATYS, Bates.

431. *aspersus*, Say.

UROGRAPHIS, Horn.

432. *fasciatus*, De G.

POGONOCHERUS, Lat.

433. *mixtus*, Hald.

SAPERDA, Fab.

434. *calcarata*, Say.
435. *candida*, Fab.
436. *tridentata*, Oliv.
437. *vestita*, Say.

OBERREA, Muls.

438. *ruficollis*, Fab.

TETRAOPES, Serv.

439. *tetraophthalmus*, Forst.

CHRYSOMELIDÆ.

DONACIA, Fab.

440. *palmata*, Oliv.
441. *magnifica*, Lec.
442. *subtilis*, Kuntz.
443. *cuprea*, Kirby.

ORSODACHNA, Lat.

444. *atra*, Ahr.
var. *childreni*, Kirby.

SYNETA, Esch.

445. *ferruginea*, Germ.

LEMA, Fab.

446. *trilineata*, Oliv.

BASSAREUS, Hald.

447. *congestus*, Fab.
448. *mammifer*, Newm.
449. var. *luteipennis*, Melsh.

CRYPTOCEPHALUS, Geoff.

450. 4—*maculatus*, Say.
451. *venustus*, Fab.

MONACHUS, Chev.

452. *ater*, Hald.

XANTHONIA, Baly.

453. 10—*notata*, Say.

ADOXUS, Kirby.

454. *vitis*, Linn.

CHRYSOCHUS, Chev.

455. *auratus*, Fab.

PARIA, Lec.

456 6.—*notata*. Say.
457. *aterrima*, Oliv.

PRASOCURIS, Lat.

458. *varipes*, Lec.

DORYPHORA, Ill.

459. *clivicollis*, Kirby.
460. 10—*lineata*, Say.

CHRYSOMELA, Linn.

461. *elegans*, Oliv.
462. *scalaris*, Lec.
463. *philadelphica*,, Linn,
var. *spiraeæ*, Say.
464. *multipunctata*, Say.
var. *Bigsbyana*, Kirby.

PLAGIODERA, Redt.

465. *viridis*, Melsh.

GASTROIDEA, Hope.

466. *polygoni*, Linn.

LINA, Meg.

467. *scripta*, Fab.
468, var. *morula*, Hausen.

PHYLLODECTA, Kirby.

468. *vulgatissima*, Linn.

DIOBROTICA, Chev.

469. 12—*punctata*, Oliv.
470. *vittata*, Fab.

TRIRHABDA, Lec.

471. *tomentosa*, Linn.
472. var. *virgata*, Lec.
473. var. *canadensis*, Kirby.

ADIMONIA, Leach.

474. *rufosanguinea*, Say.

GALERUCA, Geoff.

475. *sagittariæ*, Gyll.

ŒDIONYCHIS, Lat.

476. *quercata*, Fab.

DISONYCHA, Chev.

477. *alternata*, Ill.
478. *collaris*, Fab.

HALTICA, Geoff.

479. *bimarginata*, Say.
480. *carinata*, Germ.
481. *ignita*, Ill-

CREPIDODERA, Chev.

482. *Helxines*, Linn.
483. *cucumeris*, Harr.

SYSTENA, Chev.

484. *hudsonias*, Forst.
485. *frontalis*, Fab.

PHYLLOTRETA, Foud.

486. *vittata*, Fab.

ODONTOTA, Chev.

487. *nervosa*, Panz.

COPTOCYCLA, Chev.

488. *aurichalcea*, Fab.

BRUCHIDÆ.

BRUCHUS, Linn.

489. *pisi*, Linn.

TENEBRIONIDÆ.

PHELLOPSIS, Lec.

490, *obcordata*, Kirby.

NYCTOBATES, Guér.

491. *pennsylvanica*, De G.

IPTHIMUS, Truq.

492. *serratus*, Mann.

UPIS, Fab.

493. *ceramboides*, Linn.

SCOTOBATES, Horn.

494. *calcaratus*, Fab.

XYLOPINUS, Lec.

495. *saperdioides*, Oliv.

TENEBRIO, Linn.

496. *molitor*, Linn. 497. *tenebrioides*, Beauv.

DIAPERIS, Geoff.

497. *hydni*, Fab.

HOPLOCEPHALA, Lap.

498. *bicornis*, Oliv.

PLATYDEMA, Lap.

499. *ruficorne*, Sturm. 500. *subcostatum*, Lat.
opaculum, Casey.

BOLETOTHERUS, Cand.

501. *bifurcus*, Fab.

CISTELIDÆ.

ISOMIRA, Muls.

502. *quadristriata*, Couper.

ANDROCHIRUS, Lec.

503. *erythropus*, Kirby, (= *luteipes*, Lec.)

MELANDRYIDÆ.

PENTHE, Newm.

504. *obliquata*, Fab.

MELANDRYA, Fab.

505. *striata*, Say.

SERROPALPUS, Hellw.

506. *barbatus*, Schall, (= *striatus*, Hellw.)

PYTHIDÆ.

BOROS, Hbst.

507. *unicolor*, Say.

ŒDEMERIDÆ.

DITYLUS, Fisch.

508. *cæruleus*, Rand.

NACERDES, Schm.

509. *melanura*, Linn.

ASCLERA, Schm.

510. *ruficollis*, Say.

MORDELLIDÆ.

ANASPIS, Geoff.

511. *flavipennis*, Hald.

MORDELLA, Linn.

512. *melæna*, Germ.

MORDELLISTENA, Costa.

513. *scapularis*, Say.

ANTHICIDÆ.

CORPHYRA, Say.

514. *fulvipes*, Newm. 515. *lugubris*, Say.

NOTOXUS, Geoff.

516. *anchora*, Hentz.

ANTHICUS, Payk.

517. *formicarius*, Laf.

PYROCHROIDÆ.

SCHIZOTUS, Newm.

518. *cervicalis*, Newm.

DENDROIDES, Lat.

519. *canadensis*, Lat.

MELOIDÆ.

MELOE, Linn.

520. *niger*, Kirby.
521. *angusticollis*, Say.
522. *americanus*, Leach.

MACROBASIS, Lec.

523. *unicolor*, Kirby.

EPICAUTA, Redt.

524. *pennsylvanica*, De G.

ATTELABIDÆ.

ATTELABUS, Linn.

525. *rhois*, Boh.

OTIORHYNCHIDÆ.

PHYXELIS, Sch.

526. *rigidus*, Say.

OTIORHYNCHUS, Germ.

527. *sulcatus*, Fab.
528. *ovatus*, Linn, (=*ligneus*, ‡‡ Lec.)

CURCULIONIDÆ.

SITONES, Sch.

529. *lineellus*, Gyll.
530. *tibialis*, Hbst.

ITHYCERUS, Sch.

531. *noveboracensis*, Forst.

PHYTONOMUS, Sch.

532. *nigrirostris*, Fab.

LEPYRUS, Sch.

533. *colon*, Linn.

LISTRONOTUS, Jck.

534. *appendiculatus*, Boh.

PISSODES, Germ.

535. *strobi*, Peck.

HYLOBIUS, Germ.

536. *pales*, Hbst.

ERYCUS, Tourn.

537. *puncticollis*, Lec.

MAGDALIS, Germ.

538. *armicollis*, Say.

ANTHONOMUS, Germ.

539. *quadrigibbus*, Say.
540. *signatus*, Say.

ORCHESTES, Ill.

541. *ephippiatus*, Say.

GYMNETERON, Sch.

542. *teter*, Fab.

CONOTRACHELUS, Sch.

543. *nenuphar*, Hbst.
544. *posticatus*, Boh.

CRYPTORHYNCHUS, Ill.

545. *parochus*, Hbst.

MONONYCHUS, Germ.

546. *vulpeculus*, Fab.

BALANINUS, Germ.

547. *nasicus*, Say.

BRENTHIDÆ.

Eupsalis, Lec.

548. *minuta*, Drury.

CALANDRIDÆ.

Sphenophorus, Sch.

549. *pertinax*, Oliv.

550. *sculptilis*, Uhler.

Calandra, Clairv.

551. *granaria*, Linn.

Cossonus, Clairv.

552. *platalea*, Say.

SCOLYTIDÆ.

Xyleborus, Eich.

553. *pyri*, Peck.

Tomicus, Lat.

554. *pini*, Say.

555. *calligraphus*, Germ.

Dendroctonus, Er.

556. *terebrans*, Oliv.

Hylurgops, Lec.

557. *pinifex*, Fitch.

ANTHRIBIDÆ.

Cratoparis, Sch.

558. *lunatus*, Fab.

Proceedings of the Natural History Society.

The regular monthly meeting was held on Monday evening, November 30th, Hon. Senator Murphy, Vice-President, in the chair.

The minutes of meeting of October 26th were read and approved.

Minutes of council meeting of the 23d instant were also read.

The Librarian reported the gift of a copy of Dana's Manual of Mineralogy from Mr. Horace T. Martin. On motion of Mr. J. Stevenson Brown, seconded by Mr. F. B. Caulfield, the thanks of the society were tendered to Mr. Martin.

It was moved by Mr. J. S. Shearer, seconded by Mr. J. S. Brown, that the by-laws be suspended, and that the Hon. J. K. Ward be elected a member of the society. Carried. Mr. Ward was then elected by acclamation.

Sir William Dawson read a very interesting paper on "Trees cultivated on McGill College Grounds."

After a lengthy discussion of the paper, a vote of thanks to Sir William Dawson was moved by the Rev. Dr. Smyth, seconded by Mr. Edgar Judge. Carried.

Mr. Horace T. Martin communicated some notes on old engravings of the beaver.

The meeting then adjourned.

Proceedings of the Microscopical Society.

The regular monthly meeting of the above society was held on Monday evening, Dec. 14th, the lecturer being Sir Wm. Dawson, who chose for his subject "The use of the Microscope in the Study of Fossils." The lecture was most interesting, owing to the fact that Sir William gave, in clear, concise terms, the accumulated results of years of continuous research, and at the same time demonstrated some of the difficulties that the early investigators had to contend with, owing to the poor instruments at their com-

mand. He exhibited a "prehistoric" microscope, of date 1834, and also a number of single lenses, with a magnifying power of about 200, by the aid of which all his early work had been accomplished. He laughingly remarked "that if in the dawn of microscopy the instruments were poor, the observers had to make up for it by looking harder." Certainly nothing can mark more clearly the advance made in optical instruments, in response to the demands of science, than a comparison between the instrument of 1834 and that of to-day. Sir William demonstrated that our Montreal limestone is composed almost entirely of organic remains. He also exhibited a specimen of clay from McGill College grounds, and shewed that it contained a large number of foraminifera. Fossil sponges were treated of, and a large number of specimens, prepared by the lecturer, were examined with much interest by the members.

A vote of thanks was tendered Sir William for his courtesy in preparing so interesting a lecture and demonstration for the society.

Letters of regret at being absent were read from His Excellency the Governor-General and others.

The next meeting of the society will be held on January 11th, when Prof. Cox of McGill College will lecture on "Polarised Light, its usefulness in indicating structure," with lantern illustrations.

Notices of Books and Papers.

Manganese, its Uses, Ores and Deposits, by R. A. F. Penrose, 642 pp., Little Rock, Ark., 1891, being Volume I. of the Annual Report of the Arkansas State Geological Survey, 1890, J. C. Branner, State Geologist.

In 1889 Dr. R. A. F. Penrose, jr., assistant geologist for the Geological Survey of Arkansas, U.S., began the thorough reexamination and study of the manganese deposits of that State, and his official report, now published, proves how very complete and exhaustive have been his labors and researches, for not only has he examined personally the deposits in Arkansas, but he has visited every

known manganese region in the United States and Canada, investigating the modes of occurrence of the ore and the mining and commercial history of this important product. In this very valuable monograph are discussed (1) the uses of manganese together with the history and statistics of the manganese industry, (2) the ores of manganese and (3) the nature of manganese deposits, and to this we will be indebted for the substance of this article.

Manganese is now used for many different purposes in the arts, but by far the greater part of the ore mined is converted into the alloys of manganese and iron, spiegeleisen and ferro-manganese, which in turn play such a vital part in steel making. As an oxidizer this ore is used extensively in the manufacture of chlorine, bromine oxygen and disinfectants, and for discolorizing glass, and as a coloring material in coloring glass, pottery and tiles, calico printing and dyeing and paints.

But it is in the production of steel that manganese plays such a prominent and valuable part. In 1839, Heath, an East Indian ironmonger, patented his process by which the introduction of the carburet of manganese into steel making was made with such marvellous success that the price of steel was reduced $150 to $200 per ton. This revolution in the manufacture of steel was still further hastened by Bessemer, in 1858, introducing his perfected process in which manganese is used with great effect in his converter, leading to the great reduction in the cost of steel with the consequent vast increase in its production and consumption. Of these alloys, spiegeleisen contains less than 20 per cent. of manganese, ferro-manganese 20 per cent. and more, and their effects in steel-making are various. In the first place their presence in the converter, after the iron has lost all its carbon, and hence been reduced to wrought iron, serves to restore the proper amount of carbon to "re-carburize," or convert this wrought iron into steel. Again, manganese reduces the small but harmful quantities of iron oxide in the steel during the final melting; then passes into the slag, making it more fluid.

This metal tends to overcome to a large extent in steel-making the evil influences of sulphur and phosphorus, and when present, even in small quantities, in steel, it increases the hardness, toughness, malleability and elasticity, and when the amount reaches 8 per cent. it not only makes the steel astonishingly ductile, but also very hard.

The production of spiegeleisen and ferro-manganese in the United States is increasing very rapidly, but the supply of domestic ores is far from sufficient for the demand. In 1889, 99,481 tons were imported and 85,823 tons produced, and though in the census

year ending June 30th, 1890, the home production had greatly increased, the market is still open for large quantities of foreign ores.

Manganese is a very valuable metal in some very useful alloys, such as manganese bronze, from which the propeller screws of the largest ocean steamships are made, an alloy of remarkable strength, hardness and toughness; and silver bronze, now very largely used as a substitute for German silver, a small percentage of aluminium present greatly enhancing its value.

In its chief ores, manganese exists mostly as a carbonate or an oxide, but though true manganese ores are mined, manganiferous ores of other metals are more abundant, and in reality there is no sharp line between manganese ore proper and manganiferous iron ores which are very highly valued and readily marketable. All of the many manganese minerals on exposure to decomposition from surface influences are generally converted into oxides, and these oxyd minerals are thus more abundant, forming the greater part of American ores, and are known as pyrolusite, psilomelane, braunite, manganite and wad or bog manganese.

In Canada manganese ores have been found in many parts, but the most valuable deposits are in New Brunswick and Nova Scotia, those near the Bay of Fundy and Chignecto Bay having been the most extensively worked. Manganese was mined in Hants Co., N.S., as early as 1861, but the first real work was done at the Tenny Cape in that county in 1862 by John Brown. In 1864 the mine at Markhamville, N.B., was opened by Major A. Markham, and has been worked continuously ever since, producing up to 1890, 40,000 tons, or by far the greater part of Canada's total yield, which has been estimated at over 50,000 tons.

The most important deposits occur in the lower carboniferous limestone or the associated strata, and the ore is mostly found as an oxide, as pyrolusite, manganite and psilomelane, and especially as wad.

Nearly all our Canadian ore is shipped to the United States, where it is used in glass-making, electric batteries, as a dryer in varnishes, but very little for spiegeleisen or ferro-manganese, as it is too pure and high grade, and thus more valuable for other industrial purposes, particularly glass-making, where its freedom from iron is a very necessary quality. The Canadian deposits are such that the ore cannot be extensively mined as for spiegeleisen, but for chemical purposes its value of $40 to $100 per ton make it profitable, as at the most only $15 can be got for low grade mineral. The ore is found in the limestone in interbedded lenticular layers, nests or pockets, carrying from a few pounds to several tons, also in considerable quantities in the clays overlying the de-

cayed surface of the limestone. Much of the ore is concentrated before shipping, by crushing, washing and sizing in screens, or else shipped *en masse* as "furnace ore," to be manufactured into alloys for steel-making.

In Canada the production from 1873-1886 of manganese ore was 16,039 tons, worth $344,440, while in 1890 it was 1,455 tons, worth $32,737. In 1888 the United States produced 291,330 tons of ore, valued at $1,454,416. The demand for manganese ores is ever increasing, and it is to be hoped that new deposits will be opened up in Canada, leading to mining on a more extensive and productive scale, and adding materially to the wealth and prosperity of our Dominion.

W. A. CARLYLE, M.E.

ON THE NICKEL AND COPPER DEPOSITS OF SUDBURY, ONT., by Alfred E. Barlow, M.A. (of the Geological Survey Department).

This timely paper which appears in the June number of the *Ottawa Naturalist*, deals in general with the discovery, geological relations, mode of occurrence and composition of the nickel and copper ores in the Districts of Algoma and Nipissing, together with their preliminary metallurgical treatment as carried on in this district. The discovery of nickel in Canada dates back to 1846, when its existence in workable quantities at the Wallace mine, on Lake Huron, was made known. In 1856 Dr. T. Sterry Hunt, in his analyses of some trap collected by Mr. Alex. Murray, of the Geological Survey, from the north-western corner of the Township of Waters, showed that small quantities of nickel and copper were present. These deposits are composed of chalcopyrite very intimately mixed with nickeliferous pyrrhotite. The detection at some of the openings of polydymite, ferriferous sulphide of nickel, as well as a few undoubted crystals of millerite, seems to justify the assumption that in the more highly nickeliferous deposits, at least, the nickel is also present as a sulphide, disseminated through the ore mass like the iron and copper. These sulphides may be said to occur in three distinct ways. 1st, As contact deposits of pyrrhotite and chalcopyrite, situated betweeu the clastic rocks, such as felsites, quartzites, and intrusive diabase or gabbro, or between these latter and granite or micropegmatite. 2nd, As impregnations of these minerals through the diabase or gabbro, which are sometimes so rich and considerable as to form workable deposits. These sulphides are in no case found dissemmated through the clastic rocks at any great distance from the diabase or gabbro, which seems clear evidence

that they have been brought up by the latter. 3rd, As segregated veins which may have been filled subsequently to the intrusion which brought up the more massive deposits. These veins are not very common, although certain portions of the more massive deposits may have been dissolved out and redeposited along certain faults and fissures.

Assays made for the Canadian Copper Company, by Mr. F. L. Sperry, the chemist, show a range in the percentage of nickel from 1.12 to 4.21 per cent., with an average of 2.38 per cent., while the copper varied from 4.03 to 9.98 per cent., with an average of 6.44 per cent. Mr. Hoffmann, of the Geological Survey, assayed four samples which showed the nickel contents to vary from 1.95 to 3.10 per cent., with an average of 2.25 per cent. The metallurgical treatment commences at the roast, where the ore is piled in rectangular heaps on previously laid cordwood and roasted for fifty to seventy days, and when thoroughly done should contain about 7 or 8 per cent. of sulphur. It is then smelted in a very perfect water-jacketed furnace, the resulting product, or "matte," containing about 27 per cent, copper and 14 per cent. nickel. This is then packed in barrels and shipped to various refiners in the United States or Europe, according to their respective bids.

The paper in question is the most succinct and best report we have as yet seen upon the ores and geology of the region about Sudbury, and no one interested in the geological and mineralogical problems involved, as well as the metallurgical points with which it deals, should be without it.

H. M. Ami.

Erosion in the Desert of the Little Colorado.

In No. 3 of "North American Fauna," recently published by the United States Department of Agriculture (1890–1), Dr. C. Hart Merriam, in addition to an immense amount of most valuable information on the botany and zoology of Arizona and Idaho, gives a graphic description of the peculiar erosion topography of the Desert area, as well as an account of several cloud-bursts which he witnessed while travelling in that almost unknown region. As these cloud-bursts, although having a very remarkable effect on the character of the erosion, occur but rarely and have been but very seldom described by competent observers, the following extracts from Dr. Merriam's reports, which are of especial interest, are here reproduced:

The Desert of the Little Colorado, sometimes known as the "Painted Desert," is a great basin about 1,000 meters (3,300 feet)

in depth, situated on the top of the plateau. It was excavated, as its name indicates, by the drainage system of the Little Colorado River—the Colorado Chiquito of the Mexicans—and consequently is lowest at the north, its slope being *away* from the southern edge of the plateau. The river has cut its bed down to about 820 meters (2,700 feet) at the point where it empties into the Grand Cañon of the Colorado, and throughout the lower part of its course it flows through a cañon considerably below the level of the desert proper, the lowest part of which is but little less than 1,200 meters (approximately 4,000 feet) in altitude. Its upper limit may be set at 1,800 meters (6,000 feet). The term Painted Desert should be restricted, it seems to me, to that part of the basin which is below 1,500 metres (approximately 5,000 feet).[1]

The geology of the region is simple. The lowest stratum which comes to the surface is carboniferous limestone; above this is red sandstone, which in turn is overlaid by the so-called variegated marls or argillaceous clays, sometimes capped by a thin layer of impure coal or lignite. The limestone appears on the west side of the river only (?), where it is soon buried under the ancient lava floods from San Francisco Mountain and neighboring craters. The red sandstone is encountered everywhere, sometimes as surface rock, sometimes as high cliffs forming the escarpments of broad mesas, and sometimes as curiously sculptured tablets standing on the plain. The marls are widely distributed, and in many places, particularly south of the lower part of Moencopie Wash,[2] rise from the surface level in the form of strangely eroded hills and ranges of stratified cliffs, whose odd shapes and remarkable combinations of colors—red, white, blue, brown, yellow, purple and green—have given the area in which they occur the name "Painted Desert." There are hundreds of smoothly rounded, dome-shaped hills of bluish clay, utterly devoid of vegetation, and almost identical in appearance with the "gumbo hills," of the Bad Lands bordering the Little Missouri in North Dakota. Both the hills and the naked clayey flats between them abound in alkali vents—miniature craterlets—where the alkali effloresces, crusting over the surface in patches which resemble newly fallen snow. Many of the hills are capped with fossil wood, and many of the flats and lower levels east of the Little Colorado River are strewn with chips and pieces which have tumbled down during the wearing away of the hill-sides. Logs 30 to 50 centimeters (roughly, a foot or a foot and a half) in diameter and 9 to 12 meters (30 or 40 feet) in length are

[1] The area below 1,370 meters (4,500 feet) is about 120 kilometers (75 miles) in length, and that below 1,500 meters (5,000 feet), 200 kilometers (125 miles). The long axis of the desert, slightly crescentic in form, and curving from near the mouth of the Little Colorado in the northwest to New Mexico in the southeast, is 320 kilometers (200 miles) in length, with a transverse diameter of about 110 kilometers (70 miles) along the middle portion, and a total area of 29,800 square kilometers (11,500 square miles). Its eastern edge penetrates the boundary of New Mexico in two arms, following the usually dry courses of the Zuni and the Carrizo, and nearly reaches the boundary along the Rio Puerco, the largest tributary of the Colorado Chiquito.

[2] The terms "wash" and "arroyo" are applied to the deep channels or ravines so common in arid regions. "These arroyos are natural consequences of the unequal manner in which the rain falls throughout the year. Sometimes not a drop falls for several months; again, it pours down in a perfect deluge, washing deep beds in the unresisting soil, leaving behind the appearance of the deserted bed of a great river."—Emory, Mexican Boundary Survey, I, 1857, p. 57.

still common, and several sections were found, possibly from the same tree, which measured about 150 centimeters (5 feet) in diameter. There are pebbled beds miles in extent, made up of agate, moss-agate, chalcedony, jasper, obsidian and fossil wood, with not so much as a spear of grass or bit of cactus between them. On the other hand, many of the mesas and plains are covered with sand and decomposed marls, which support a scanty growth of cactus, yucca, grease-wood and a few other forms of vegetation characteristic of arid regions.

The bed of the Little Colorado River contains the only running water in this part of Arizona, and it "goes dry" a large part of the year, a little water remaining in scattered pools, which are strongly alkaline. Some of the salt and alkali flats on the river-bottom support a luxuriant growth of a singular fleshy plant belonging to the genus *Salicornia*, which at a little distance looks like a leafless bush with green stems. During the rainy season, and whenever the river "runs," the liquid which flows down its course is red alkaline mud, about the consistency of ordinary sirup. This is the case also with its tributaries, of which Moencopie Wash and Tenebito Wash are the only ones which cross the Painted Desert proper.

The physical and climatic features of the Painted Desert are peculiar and striking, and result in the production of an environment hostile alike to diurnal forms of animal life and to the person who traverses it. The explorer is impressed with the unusual aspects of nature—the strange forms of the hills, the long ranges of red and yellow cliffs, the curiously buttressed and turreted buttes and mesas, the fantastic shapes of the rocks carved by the sand-blast, and rendered still more weird by the hazy atmosphere and steady glare of the southern sun, the sand-whirls moving swiftly across the desert, the extraordinary combination of colors exposed by erosion, the broad clayey flats whitened by patches of alkali and bare of vegetation, the abundance of fossil-wood, the extensive beds of shining pebbles, the unnatural appearance of the distant mountains sharply outlined against the yellow sky, the vast stretches of burning sand, the total absence of trees, the scarcity of water, the alluring mirage, the dearth of animal life, and the intense heat, from which there is no escape.

The Plateau region of the interior of North America is noted for its scanty rain-fall, and the same may be said of Arizona as a whole. The annual precipitation and mean humidity are greatest on the high mountains and least on the low plains and deserts. The San Francisco Mountain has many times the rain-fall of the Little Colorado Desert, near by, and the quantity of aqueous vapor in the air is correspondingly higher. Evaporation is retarded by the clouds which frequently rest upon the summit, and by the dense spruce forests which protect the soil from the direct rays of the sun, enabling it to retain enough moisture to permit the growth of plants requiring a humid atmosphere for their existence.

There are two rainy seasons on the San Francisco Mountain plateau: one in summer, usually in July or August, the other in mid-winter. The summer rainy season is characterized by daily thunder-showers. As a rule, several such showers occur each day, and not infrequently several may be seen at the same time from any of the volcanic cones. The area covered by each is very small, its diameter rarely exceeding half, or even a quarter of a mile;

and its duration is brief, though the rain-fall may be considerable. The accompanying thunder is often terrific, and the lightning vivid and destructive. Tall pines are shattered on every hand, and cattle are frequently killed; three were killed by one stroke near our camp about the middle of August. The showers almost always take place in the day-time, and are most common at mid-day and in the early afternoon. In fact, it is a common saying in this region that it never rains at night. Two partial exceptions to this rule occurred during our stay, one in which an unusually severe and protracted rain lasted from about 3 o'clock in the afternoon until 9 or 10 in the evening; the other, a light shower which actually took place in the night. During the latter part of the rainy season the showers became less frequent, but extended over a larger area and lasted longer. The axis of abundance seems to be between San Francisco and Kendrick Peaks, but the greatest precipitation occurs on San Francisco Mountain, as would be expected from its great altitude. The summit of the mountain is so cold that it is occasionally whitened with snow while rain falls at its base; and hail-storms are frequent both on the mountain itself and throughout the plateau region, many sudden storms taking this form.

Over much of the pine plateau the soil consists of decomposed lava, and is so porous that the rain sinks out of sight as it falls, and the atmosphere is so dry and evaporation so rapid that a few minutes after a shower no traces of it are visible.

On the arid desert of the Little Colorado rains are infrequent, but usually of great violence, producing torrents which cut deep washes or "arroyos" in the sun-baked sand and clay. Sometimes cloud-bursts deluge large areas, flooding the valleys and destroying multitudes of the smaller mammals. Three storms of this character were witnessed, two of moderate size, the third of great dimensions, and striking evidences of a fourth were everywhere noticeable when we reached the region. This latter almost inundated the town of Flagstaff and several other places along the line of the Atlantic & Pacific Railway, and left unmistakable evidences of its volume and force in various directions, the most impressive, perhaps, being the overflow of a crater lake and adjoining craterlet just east of Kendrick Peak. The track of the torrent that rushed down the sides of this crater, and for a distance through the pine forest beyond, suggested a veritable volcanic eruption.

While following the course of Tenebito Wash across the Painted Desert, we saw a heavy rain-storm raging over the high mesas to the north and east during the entire afternoon of August 14, though not a cloud came between us and the parching sun. Before dark a furious wind—the vehicle of a sand-blast—swept down the wash between the rows of cliffs which mark its course, abating as night came on. About 10 o'clock we were startled by a loud roaring in the north, which at first gave the impression that a severe storm was advancing upon us, but not a cloud could be seen, and the stars shone brightly in every direction. The roaring increased and came nearer until it was evident that something was coming down the bed of the wash; and in a moment a great wave of thick mud rushed past with a tremendous roar, accompanied by a fetid stench. The first wave was about 1½ metres (5 feet) high, but it soon rose to 2½ meters (8 feet), where it remained for an hour, and then

slowly subsided. After 3½ hours it was still about 1½ meters (5 feet) deep and running swiftly, and it had not entirely ceased three days later.

Two days afterward (August 16), when at the Moki Pueblo of Oraibi, a furious rain set in about 4 p.m., and lasted more than an hour, flooding the house-tops and 'streets and parts of the valley below. And yet the desert was as parched next day as if it had never been wet.

The heaviest and most extended rain-fall observed by us occurred September 20, on which date Mr. Bailey and I set out from Little Spring for Moencopie. Heavy laden clouds began scurrying over the mountain toward the northeast early in the morning, and by noon the entire sky was overcast and had a most ominous appearance. Soon the rain began falling in torrents, and the storm moved steadily eastward from the edge of the lava-beds to the Little Colorado, and thence across the desert to the high mesas beyond. Such a deluge I never saw, and we afterwards learned that it extended 160 kilometers (nearly 100 miles) to the south. The gulch in the edge of the lava-beds, about 2½ kilometers (1½ miles) east of Black Tank, was full to overflowing; the flat upon which it empties was 1½ meters (5 feet) under water; great lakes appeared in various parts of the desert, and the Little Colorado bottom was completely flooded. And yet all this vast volume of water disappeared in a few hours. A red, sirupy, alkaline mud filled the bed of the Little Colorado for a few days, and pools of similar mud were occasionally found in depressions in the sand-rock all the way to Moencopie. The whole desert, from the San Francisco lava-beds on the west to Echo Cliffs on the east, showed that it had been recently deluged, as if by the breakage of some mighty dam, but the water had disappeared.

From the scanty data available, and from the experience of residents of the region, it is safe to infer that the rain-fall was unusually heavy in the Plateau region during the summer of 1889.

In No. 5 of the "North American Fauna," Dr. Merriam also makes the following observations on the effects of water-courses on the geographic distribution of species:

Mountain streams, in passing down into the plains, exert a two-fold influence on the distribution of animals and plants. By their constant efforts to reach base level, these streams are continually cutting down and lengthening the valleys in such a way as to produce gradually sloping bottom lands, which penetrate the highlands from the plain below, carrying with them narrow prolongations or tongues of the fauna and flora of lower levels, which follow the the contour lines in a general way.

The second effect mentioned is of an exactly opposite character. The low temperature of the water, coming from melting snow-banks or cold springs in the mountains, lowers the temperature of the soil supporting the vegetation on its immediate banks, while the evaporation from its surface cools the air to which the foliage of such vegetation is exposed, thus bringing the northern or higher fauna and flora down along the immediate course of the stream.

The length of the stream and steepness of the slope determine whether the first or second effect is most pronounced. Rivers having long courses over the plains, such as the Missouri and

Platte, become so thoroughly warmed during their long journey that the second effect is inappreciable, while the first is very strongly marked, southern forms of life ascending these valleys a hundred kilometers or more beyond the usual limit. Short streams, on the other hand, and particularly those that head in mountains and have rapid courses, carry northern forms many kilometers below their normal limit, but do not afford the same facility for the northward extension of southern forms. Streams of intermediate character (in the respects indicated) present intermediate conditions, and where the two types balance, the northward (or upward and southward (or downward) extensions of the life zones are of equal length, the latter inclosing the former like the involuted finger of a glove.

THE BIRDS OF MANITOBA. By Ernest E. Thompson, Toronto, Canada. Proc. U. S. National Museum, Vol. XIII, 1890.

In this pamphlet of 643 pages, the author gives the results of three years' field studies of the birds of Manitoba, supplemented by numerous quotations from previous writers and unpublished manuscripts, notably the unpublished "Observations on Hudson's Bay," by Thos. Hutchins, for twenty-five years prior to 1782 an agent of the Hudson's Bay Company. Mr. Thompson has also availed himself of a number of reports communicated to the A. O. U. Committee on Bird Migration, bringing together a large amount of information respecting the ornithology of a district of which previously but comparatively little was known. The author's own field notes are very full, particularly with regard to the nesting habits and singing powers of many species, and bring vividly before us charming pictures of bird life, amidst the whispering woods and on the breezy prairies. The work consists of five parts, (1) an introduction giving the boundaries and physical features of the province; (2) an "Annotated list of the birds," numbering 266 species and subspecies; (3) "A chronological list of the principal books and articles consulted;" (4) "A list of the manuscripts used in completing the foregoing notes;" (5) index. The paper is accompanied by a map showing the distribution of the prairies, sand dunes and marshes and the deciduous and coniferous forests, the whole forming a very important addition to the literature of Canadian ornithology. It is to be regretted that the mechanical portion of the undertaking is not equally praiseworthy, the presswork being very poor indeed, and typographical errors by no means infrequent.

F. B. CAULFEILD.

Taxidermy and Zoological Collecting. By William T. Hornaday. New York, Charles Scribner's Sons, 1891.

To the enthusiastic boy naturalist, waging a losing battle with the mangled remains of what once was a bird or small mammal, this book will be a revelation and a delight, telling him plainly and pleasantly everything necessary to enable him to skin, preserve and set up his bird or squirrel.

To the advanced worker it will be equally welcome, giving the latest and most approved methods of work, with a copiousness of detail and wealth of illustration exceedingly gratifying when compared with previous works. In truth, however, the plan of Mr. Hornaday's book is so comprehensive and so ably carried out, that it cannot fairly be compared with any of its predecessors, many of the methods and appliances described being either the author's own inventions or improvements upon those already in use, especially with respect to mounting the larger mammals and scaled fishes. Stress is laid upon the necessity of taking a full series of measurements and outline drawings, and the importance of accurate notes of all specimens, with sketches, so as to trust nothing to memory. Sound advice that, if followed, would save endless trouble. While preferring the clay-covered manikin for mounting mammals larger than a squirrel, the author describes the method of mounting with a soft body, as practised by the French taxidermists, viz., filling around a central support with tow or similar material. For the smaller mammals the writer prefers using a hard body, similar to that described for mounting birds, exactly copying the natural body as to size and form. For absorbing moisture or grease the writer much prefers fine sawdust to either plaster of Paris or cornmeal, the former covering everything with a fine film of dust, and when mixed with liquified grease forming a gummy cement very difficult to get rid of, while the latter is too hard to absorb moisture quickly. The book is divided into six parts: (1) Collecting and preserving. (2) Taxidermy. (3) Making casts. (4) Osteology. (5) The collection and preservation of insects (by Rev. W. J. Holland). (6) General information. Each subject is exhaustively treated, leaving little or nothing to be desired, every page bearing witness that it is written by one who loved his work and spared no pains to make himself master of it. It is illustrated by twenty-four plates and eighty-five cuts in the text.

F. B. Caulfeild.

BER, 1891.

1, 187 feet. C. H. McLEOD, *Superintendent.*

KY CLOUDED N TENTHS. Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
4.8	10	0	85	....	....	....	1
3.0	10	0	59	....	....	....	2
0.0	0	0	92	....	....	....	3
...	..	..	50	....	....	....	4 ....SUNDAY
5.3	10	0	19	0.06	....	0.06	5
2.2	7	0	96	....	....	....	6
9.7	10	8	00	0.15	....	0.15	7
5.7	10	0	00	0.78	....	0.78	8
3.3	10	0	00	....	....	.. .	9
3.8	10	0	70	...	....	....	10
...	..	..	93	0.02	1.00	0.12	11 ....SUNDAY
0.0	0	0	94	....	...	....	12
7.7	10	0	00	....	....	....	13
5.0	10	0	18	Inap.	....	Inap.	14
5.5	10	0	00	0.06	....	0.06	15
9.2	10	5	62	Inap.	....	Inap.	16
4.2	10	0	32	....	....	....	17
...	..	..	94	....	....	....	18 ....SUNDAY
2.5	9	0	84	....	....	....	19
0.0	10	10	00	0.93	...	0.93	20
6.7	10	0	03	0.04	....	0.04	21
8.2	10	0	15	....	Inap.	Inap.	22
7.5	10	2	25	....	....	....	23
6.7	10	0	03	....	....	....	24
...	..	..	86	....	....	....	25 .... .SUNDAY
0.0	10	10	42	0.16	....	0.16	26
0.0	10	10	00	0.13	0.50	0.18	27
4.2	10	0	84	....	....	....	28
4.3	10	0	07	....	....	....	29
3.8	10	0	68	0.01	....	0.01	30
9.8	10	9	16	0.04	....	0.04	31
6.0	....	....	41.9	2.38	1.50	2.53	Sums ....
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the 12th;
31st, giving

a range of 1.212 inches. Maximum relative humidity was 98 on the 21st. Minimum relative humidity was 42 on the 9th.

Rain fell on 13 days.

Snow fell on 3 days.

Rain or Snow fell on 14 days.

Hoar frost on 2 days.

Lunar corona on the 16th.

Fog on 2 days.

…MBER, 1891.

…, 187 feet. C. H. McLEOD, *Superintendent.*

D…	…y Clouded …n Tenths. …	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
SUNDAY	..		..	15	0.13	....	0.13	1 ....SUNDAY
	.7	10	0	42	....	....	....	2
	.3	8	0	76	....	....	....	3
	.7	10	0	73	....	....	....	4
	.0	10	0	33	....	....	....	5
	.0	0	0	94	...	....	....	6
	.3	10	0	83	....	....	....	7
SUNDAY	..	..	..	88	....	....	....	8 ....SUNDAY
	.7	10	0	71	....	....	....	9
	.5	10	0	00	....	....	....	10
	.0	10	0	85	0.52	....	0.52	11
	.7	10	2	00	0.15	....	0.15	12
	.2	10	0	00	Inap.	....	Inap.	13
	.3	10	0	69	Inap.	Inap.	Inap.	14
SUNDAY	..	..	..	94	....	....	....	15 ....SUNDAY
	.0	10	10	00	0.20	0.60	0.26	16
	.0	10	9	00	0.49	.	0.49	17
	.0	10	0	65	....	Inap.	Inap.	18
	.7	10	0	13	....	....	... .	19
	.0	10	10	00	....	....	....	20
	.0	10	10	00	0.06	...	0.06	21
SUNDAY	..	..	.	00	0.36	....	0.36	22 .... SUNDAY
	.0	10	10	00	0.35	....	0.35	23
	.0	10	10	00	0.38	....	0.38	24
	.3	10	0	09	....	0.70	0.07	25
	.3	10	0	49	Inap.	....	Inap.	26
	.0	10	10	21	0.07	0.10	0.08	27
	.7	10	0	00	....	2.00	0.20	28
SUNDAY	..	..	..	91	....	....	..	29 ....SUNDAY
	.2	10	0	07	....	0.10	0.01	30
......	.2	....	....	35.9	2.71	3.50	3.06	Sums ....
17 Ye… for and this mo…	.3	....	....	¶30.4	2.43	12.8	3.72	17 Years means for and including this month.

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a range of 1.599 inches. Maximum relative humidity was 100 on the 1st. Minimum relative humidity was 46 on the 19th and 20th.

Rain fell on 13 days.

Snow fell on 7 days.

Hail fell on 2 days.

Rain or Snow fell on 17 days.

Lunar halo on 15th.

Lunar corona on the 14th.

MBER, 1891.

vel, 187 feet. C. H. McLEOD, *Superintendent.*

Sky Clouded in Tenths.			Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
Mean.	Max.	Min.					
7.8	10	0	55	....	....	....	1
6.0	10	0	73	....	....	....	2
2.7	10	0	53	....	....	....	3
7.5	10	0	28	0.50	0.5	0.55	4
4.8	10	0	68	0.02	...	0.02	5
....	..		76	....	Inap.	0.00	6 ....SUNDAY
8.0	10	0	00	....	2.6	0.26	7
4.7	10	0	82	...	....	....	8
5.5	10	0	62	....	....	....	9
6.2	10	0	62	....	....	....	10
2.8	10	0	81	....	....	....	11
7.7	10	0	23	....	....	....	12
....	..	..	88	....	....	.. .	13 ..... SUNDAY
7.8	10	0	01	....	.	....	14
8.3	10	0	00	0.14	6.0	0.74	15
10.0	10	10	00	0.15	1 6	0.31	16
3.3	10	0	00	....	Inap.	0.00	17
6.7	10	0	65	....	Inap.	0.00	18
5.8	10	0	68	....	Inap.	0.00	19
....	..	.	01	....	....	....	20 ....SUNDAY
5.0	10	0	31	....	....	....	21
9.2	10	5	00	0.03	...	0.03	22
10.0	10	10	00	0.46	....	0.46	23
8.3	10	0	00	0.02	0.3	0.05	24
10.0	10	10	00	0.02	....	0.02	25
10.0	10	10	00	0.23	....	0.23	26
....	..	..	57	....	Inap.	0.00	27 .... .SUNDAY
1.8	10	0	68	.. .	....	..	28
10.0	10	0	03	0.36	....	0.36	29
5.0	10	0	32	0.21	1.0	0.31	30
0.0	0	0	91	....	....	....	31
6.48	....	....	37.7	2.14	12.0	3.34	Sums ....
7.08	....	....	¶29.3	1.39	23.7	3.73	17 Years means for and including this month.

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17th. Highest
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midity was 98 on 3 days. Minimum relative humidity was 47 on the 5th.

Rain fell on 11 days.

Snow fell on 11 days.

Rain or Snow fell on 17 days.

Hoar frost on 5 days.

Fog on 5 days.

Coloured solar halos of 22° and 46° with contact arcs and parhelia on the 6th.

Note.—The mean temperature of this month was 10.°7 above the normal and is the highest for December in the Seventeen Years over which the present series of observations extends.

YEAR 1891.

Observa[illegible]e N. 45° 30′ 17″. Longitude 4h 54m 18s.55 W.

C. H. McLEOD, *Superintendent.*

MONTH.	Number of days on which rain fell.	Inches of snow.	Number of days on which snow fell.	Inches of rain and snow melted.	No. of days on which rain *and* snow fell.	No. of days on which rain *or* snow fell.	MONTH.
January	6	21.0	23	3.30	5	24	January ....
February	8	18.7	15	3.14	5	18	February.........
March	9	16.3	8	3.92	2	15	March ....
April	12	7.1	6	3.26	2	16	April...........
May	12	....	1	1.71	1	12	May ....
June............	8	....	..	1.75	..	8	June............
July	20	....	..	4.80	..	20	July............
August	14		..	3.70	.	14	August..........
September	14	....	..	1.03	.	14	September.......
October..........	13	1.5	3	2.53	2	14	October..........
November	13	3.5	7	3.06	3	17	November ....
December	11	12.0	11	2.34	5	17	December. ......
Sums for 1891 ...	140	80.1	74	35 54	25	189	Sums for 1891 ...
Means for 1891 ..	....	....	....	2.96	..	16	Means for 1891 ..
Means for 17 years ending Dec. 31, 1891.	134	122.0	83	39.97	16	201	Means for 17 years ending Dec. 31, 1891.

* Baromet[illegible]ndicates that the temperature has been *higher;* "—" that it has been *lower* than the av[illegible]ndard time. The anemometer and wind vane are on the summit of Mount Royal, [illegible]

The greate[illegible]t range of the thermometer in one day was 40.9 on Jan. 1st: least range was 4°.1 o[illegible]ture was 6°.7 below zero. The highest barometer reading was 30.725 on Feb. 14th and [illegible] 7th. The greatest mileage of wind recorded in one hour was 59 on Mar. 3rd, and th[illegible]ear was S.52° W., and the resultant mileage 51,200. Auroras were observed on 12 n[illegible]alos on 8 days and on Dec. 6th, coloured halos of 22° and 46° with contact arcs and[illegible]wfall of the autumn was on October 11th. The first sleighing of the winter was on D[illegible]

NOTE.—Th[illegible]

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VOLUME V. NUMBER 2.

THE CANADIAN RECORD OF SCIENCE

INCLUDING THE PROCEEDINGS OF
THE NATURAL HISTORY SOCIETY OF MONTREAL,
AND REPLACING

THE CANADIAN NATURALIST.

CONTENTS.

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Alex^r. Murray

THE

CANADIAN RECORD

OF SCIENCE

VOL. X. APRIL, 1906.

ALEXANDER MURRAY, F.G.S., F.R.S.C.

By Robert Bell, B.A.Sc., M.D., LL.D.

The subject of this biographical sketch was a [illegible] prominent geologist of Canada [illegible] from the commencement of the Geological [illegible] provinces in 18[illegible] till 1864, and after[illegible] of the [illegible] Survey of the [illegible] of Ne[illegible] from 18[illegible] to 1883. Owing to his [illegible] by the [illegible] his active [illegible] between [illegible] countries, it could not be expected that [illegible] persons would know much of him [illegible] Indeed there are but few [illegible] who [illegible] personally and at the same time [illegible] of [illegible] Having had a [illegible] acquaintance with [illegible] many and being conversant with his labours in both spheres, I have been asked to write a short account of his life.

His services to the topography and geology of Canada and Newfoundland were very important, and deserve to be gratefully remembered. Although he was a well-known [illegible] in old Canada during the period of his active employment, so rapid are the changes in a country like ours and so quickly do the new [illegible] occupy the places of the pioneers, that the labours of Murray are among [illegible]

THE

CANADIAN RECORD

OF SCIENCE.

VOL. V. APRIL, 1892. NO. 2.

Alexander Murray, F.G.S., F.R.S.C., C.M.G.

By Robert Bell, B.A.Sc., M.D., LL.D.

The subject of this biographical sketch was assistant provincial geologist of Canada (as it was before Confederation) from the commencement of the Geological Survey of the united province in 1843 till 1864, and afterwards director of the corresponding Survey of the island of Newfoundland from 1864 to 1883. Owing to his having divided the period of his active life almost equally between the two countries, it could not be expected that many persons would know much of his career in both. Indeed, there are but few at this day who are familiar with his personal and at the same time his scientific history in either of them. Having had a long personal acquaintance with Mr. Murray, and being conversant with his labors in both spheres, I have been asked to write a short account of his life.

His services to the topography and geology of Canada and Newfoundland were very important, and deserve to be gratefully remembered. Although he was a well-known figure in old Canada during the period of his active employment, so rapid are the changes in a country like ours, and so quickly do the new comers occupy the places of the pioneers, that the labors of Murray are already being

forgotten; and, at most, only a vague impression remains of what he actually accomplished even among those who have most to do with similar work in these provinces at the present time.

A brief sketch of the career of Alexander Murray, and a succinct enumeration of his work which would help to preserve to him the credit of his labors ere it is too late, would, therefore, be not only a just tribute to his memory, but a useful record for reference hereafter in regard to the geography and geology of Canada and Newfoundland. For these reasons I have been induced to respond to the above mentioned request; and in undertaking this duty I propose in the personal part of the narrative to paint a true picture, giving the shadows as well as the lights, so that the reader may form a correct estimate of his character.

It was my good fortune to be tolerably well acquainted with Mr. Murray's history both in Canada and Newfoundland—otherwise I would not have attempted the present task. Not only was I associated with him for seven years at the headquarters of the Geological Survey in Montreal, but I accompanied him one year, as assistant, to his favorite haunts among the Huronian rocks of Lakes Superior and Huron, which, it is well known, he was the first to investigate; and, as regards Newfoundland, I have had opportunities of going over his work in different parts of the island and afterwards of discussing its geology with him during several weeks' residence at St. John's in the winter of 1868–69. Where my own knowledge was lacking at any point, I have obtained the requisite information through the kindness of friends of his in both countries. Among those in Canada I would mention Major Joseph Wilson of Sault Ste. Marie, Mr. John Johnson and Mr. Scott Barlow of Ottawa, former assistants; and as to Newfoundland, his widow, now resident in Edinburgh, Mr. Thomas C. Weston of Ottawa, Rev. Moses Harvey of St. John's, and more particularly Mr. James P. Howley, his assistant on the Island, to whom further reference will be made.

Mr. Murray was a friend of my late father, the Rev. Andrew Bell, who had given much attention to the geology of Upper Canada and had mapped the distribution of the rocks in the lake peninsula, according to the divisions which had been made by the geologists of the State of New York, before the commencement of the government Geological Survey of Canada. It was when on a visit to my father, in 1850, who was then living in Dundas, that I first saw Mr. Murray. Although only a boy at that time, I had a distinct recollection of him as a bright, genial and pleasant looking man. On this occasion my older brothers assisted him to measure the strata in the cliffs around the head of Lake Ontario, among which was the "Sydenham Road Section," published in his report for that year and which has been so often used for reference in regard to the rocks of the surrounding country. During this visit, my father, who was familiar with the country northward to Georgian Bay, furnished Mr. Murray with information which enabled him to lay out his time, in examining it, to the best advantage—all of which he acknowledged in his report to the government. I renewed Mr. Murray's acquaintance in 1857, when I joined the staff of the Geological Survey, and have followed his labors to the close of his life.

When in St. John's in the winter of 1868–69, I was requested by the government to give evidence as to the value of Mr. Murray's survey of the island. This evidence was published by the government, and was said to have influenced the legislature in continuing the survey.

It was during 1868 that Mr. Murray was fortunate enough to secure the services of Mr. James P. Howley, who continued to assist him with so much ability in the prosecution of the survey until his retirement in 1883, since which time, with one interruption, Mr. Howley has carried on the work alone up to the present year.

Before attempting to trace Murray's career as a geologist, we shall notice briefly his family history up to the time of his leaving for Newfoundland, and further on give a similar notice of his domestic relations in that

colony. Murray was remarkable for having, as it were, duplicated his life-history, or to have enjoyed two separate spans of life of about the same duration, in each of which his career was very similar in nearly all respects. He repeated in Newfoundland the same kind of preliminary geological and topographical work he had done in Canada, and having married and brought up a family in the latter province, he became a widower, and, on going to Newfoundland, married again and reared a second family of children. So completely separate were his two spheres that one is apt to think of him as he would of two distinct individuals, and his biography must necessarily branch into two separate parts.

Murray was born at Dollerie House, Crieff, in Perthshire, Scotland, on the 2nd of June, 1810, and died in the same town on the 16th of December, 1884, in his 75th year. He was the second son of Anthony Murray, Esq., of Dollerie House, Anthony being the eldest, and William, who was killed in the Indian mutiny in 1857, being the third son. They belonged to the family of the Murrays of Ochtertyre, referred to by the poet Burns in his song "Blithe was She," and were cousins of Sir Patrick Murray, the present proprietor of the estate of his forefathers.

His first wife was Fanny Judkins, of Liverpool, a sister of the late Captain Judkins, well known for many years as the commodore of the Cunard line of steamships. By her he had a son and two daughters. The son, Anthony Hepburn, born in Scotland 30th October, 1840, adopted the military profession, and has been an officer in India since about 1857. He is still in that country, and is now a colonel in the Horse Artillery. His eldest daughter, Mary Helen, born at Woodstock, Upper Canada, 2nd October, 1838, married, about 1856, Mr. Frank Elwes, then of Woodstock, and soon afterwards removed with her husband to England. She has been a widow for some years, and is still residing in England. The second daughter, Helen, born at Woodstock 19th March, 1843, married, in 1861, Bernard Fabricotti, proprietor of the Carrara

marble quarries in Italy, but she and her husband lived most of the time in London, where she died in 1882.

Murray was educated at the Royal Naval College, Portsmouth, entered the navy in 1824 as midshipman, passed for lieutenant in 1833, and retired in 1834. Although he did not remain long in the service, the atmosphere of a man-of-war of those days clung to him throughout life. He was fond of nautical terms and illustrations and the strong language of naval officers of the olden time. On account of these peculiarities, when he removed to the seafaring colony of Newfoundland he was christened Captain Murray by the people, and among them was always known by this honorary title.

During his career as a naval officer he had an opportunity of seeing some active service, and was present in the "Philomel" at Navarino on the 20th of October, 1827, where he was wounded, and received a medal for the part he took in that engagement. At the time of the rebellion of 1837–38 in Upper Canada he volunteered his services to the government and was on duty for a short period.

The salary attached to the position of assistant provincial geologist does not appear to have been sufficient to secure his services for the entire year, and Murray was allowed to devote part of his time to agriculture. He purchased land in the township of Blandford, not far from Woodstock, one of the best districts in the upper province, and continued to hold his farm all the time he was connected with the Geological Survey of Canada. For the first few years he kept the management of it in his own hands, his wife looking after matters while he was absent on geological field-work a part of each summer or at the office of the Survey in Montreal a portion of each winter. He found, however, that in his case "gentleman farming" would not pay, and so he rented this property and took a house in Woodstock. Here his wife died in the winter of 1862–3 while her husband was temporarily residing at the headquarters of the Survey in Montreal.

Murray was a man of medium height, rather fair complexioned, with blue eyes and flaxen beard. He was well built and had powerful muscles until he was overtaken by a paralytic stroke previous to 1856, after which he refrained from performing the feats of strength in which he had formerly delighted. The portrait accompanying the present sketch is from a photograph taken at Crieff in 1867.

He was noted as an ardent sportsman and lover of dogs, guns and fishing-rods. But he confined himself to the lines he could follow in a wild country, and neglected most of the sports of civilized regions, such as horse-racing, cricket, etc. But when Murray was a young man, before public sentiment became so refined as it is at the present day, he did not deny having a weakness for the "manly art" and some other sports which are now tabooed in "society."

The animals he killed during his surveys and explorations in the backwoods always formed a welcome addition to the diet of salt pork, and often it constituted the only food in camp. He was an excellent shot with both rifle and gun, and many a bear and deer fell under his aim, to say nothing of the multitudes of ducks, grouse, snipe, woodcock and other wild fowl. He had a great fondness for fly-fishing, which he considered "the grandest sport in the world," and he would go into raptures over the capture of an extra big trout.

To show how confident he felt of his skill as a marksman the following anecdote may be related:—On one occasion when at the Sault Ste. Marie several land surveyors arrived on their way into the back country where they were going to run base lines and lay out townships. Murray had explained to them the use of the Rochon micrometer telescope, with which he measured most of his distances, when one or two of the surveyors expressed a wish to see a practical demonstration of the working of the instrument. For this purpose they sent one of their voyageurs, a Frenchman, to take Mr. Murray's disc-staff to the small island opposite Capt. Wilson's house, where he was to hold it erect at

any spot Mr. Murray might indicate after he had landed. Murray told him that he was to move the staff to whichever side he might wave his hat. "C'est bien, Monsieur," said the voyageur, as he pushed off in his canoe. The first position he selected not suiting Mr. Murray, the latter took off his hat and waved him the pre-arranged signal. The man had evidently misunderstood, for while continuing to hold the disc-staff in a provokingly negligé style, he took off his own hat and waved it most gracefully to the same side. This made Murray furious, and he signalled wildly with his hat to the other side. The man changed hands on the staff and waved more elegantly than even on the corresponding side. Words failed Murray for the occasion, and, gasping for breath, he handed the micrometer to some one near him and ran for his rifle. The voyageur wore his Sunday coat, a light alpaca. It was hanging open from his shoulders and blown a little way out from his body. With a steady hand Murray sent a bullet through the fluttering coat-tails, which evidently gave the man a jerk at the instant he heard the crack of the rifle, for he dropped the staff, exclaiming, "Mon Dieu, je suis tué."

A cold bath every morning was regarded by Murray as more essential than his prayers, and no matter how inclement the weather might be, or how inconveniently his tent might happen to be pitched for getting at the water, he would never allow the cold, rain or wind, or such obstacles as a marsh, a jam of driftwood or the tangled brush, to prevent him reaching deep water and enjoying his "dip." Late in the autumn, after the snow had whitened the ground and the ice was forming around the shores, he still continued the practice with unabated rigor. Cleanliness was a sort of hobby with him, and he had a very poor opinion of anyone who did not "tub" with reasonable regularity. When on an exploratory "traverse" in the woods, if a river or a narrow lake lay across his course, he would not hesitate to plunge in and swim to the other side rather than lose time in making a raft, as most explorers do under such circumstances.

His duties as an explorer in the forest regions soon rendered him an expert bush-ranger and canoeman, while his experience at sea had taught him to handle sail-boats well. The freedom of the woods and waters of the west had a great fascination for Murray, and I have often heard him say how much he preferred life in the bush to that in Canadian civilization.

He took little interest in the public affairs of Canada, but in British politics he was a most pronounced Tory. Without being a tuft-hunter, he had a great admiration for the Scotch and English aristocracy, and attributed to their influence, more than to anything else, the prestige which the nation has won, not only in arms but in all the arts and sciences which flourish in Great Britain.

In matters of belief Mr. Murray was a Protestant, and although not much known in "religious circles," he led a straightforward life and had a cordial detestation of every kind of cant and hypocrisy. Although very outspoken and sometimes not over choice in the language he used in the society of men, among women he was gentle, affable and delightfully polished in manner and conversation. He was fond of children, kind to the poor, and in cases of sickness or misfortune was considerate, generous and sympathetic.

Socially, Mr. Murray was always in great demand during his sojourn both in Canada and Newfoundland, although he was not very fond of "going out" in society. When he and Sir William Logan were present in any social assembly they always formed the centre of attraction and charmed the company with their entertaining stories, jokes, or general conversation, and occasionally by a song. These were cheerful days in the Survey offices in Montreal. Every now and then the pleasant voice of Logan or Murray might be heard echoing through the rooms, and the dull, quiet work over maps, rocks and fossils, was relieved by many a hearty laugh. A visit to the museum was a treat to strangers if they should be fortunate enough to be escorted through it by either of these men.

Murray's voice was seldom heard in public, yet he was a good speaker when occasion required. His speech at the Toronto banquet to Logan after his return, newly knighted, from the Paris Exhibition of 1855, was the best of the evening, and was regarded as a very fine effort. On 15th February, 1869, I had the pleasure of listening to his popular lecture on "The Economic Value of a Geological Survey," delivered in the Athenæum Hall in St. John's before a large and intelligent audience, which included the governor of the colony and most of the members of both branches of the legislature. The subject matter of itself, his method of treating it and the delivery, were all excellent and called forth a very hearty vote of thanks.

Usually good natured and genial, Murray was, nevertheless, quick-tempered, and in the heat of provocation sometimes said or did what he immediately after repented. Many stories might be told in illustration of this trait in his character, but two or three must suffice.

On one occasion, when sitting beside Sir William Logan at a public dinner at the St. Lawrence Hall in Montreal, one of the waiters gave him some impudence. In a moment Murray was on his feet and knocked the man's head against the wall behind him. In the morning Murray, hearing that the waiter was about to take out a warrant against him for assault, made haste to have him arrested for using insulting language. Whereupon the man was glad to compromise matters, and the affair dropped.

In 1860, on our return from a coasting voyage along the south shore of Lake Superior, Mr. Murray and I were camped at the head of the portage on the Canadian side of the Sault Ste. Marie. One of our men, Pierre Pilon by name, a well known character in these parts, became somewhat the worse of liquor, and was seized with a desire to have a letter written to his wife at Shi-ba-o-na-ning, of whom he seldom thought when sober. Mr. Murray was lying on his back in his little tent reading a book and enjoying a much needed rest. Every little while Pilon would put his head into the tent door and again request

him to write the letter, always forgetting he had already done so more than once. Mr. Murray put him off, good-naturedly at first, but with increasing wrath each time the man nagged him, and also reminded him in more and more forcible language that he was drunk. The last time he thrust his head into the tent Murray's face "spoke volumes" without his uttering a word. In an unguarded moment the half-intoxicated Pilon changed the subject and remarked, "Monsieur Murra, you look lak 'e dev, sair." Murray threw down his book, sprang to his feet and seized the rifle which always lay beside him. Pilon had only a moment to run behind the large canoe-house near by. Before Murray's temper could cool to a reflective stage he had made the circuit of the building several times in pursuit of the fugitive. Then, doubling back on him, there was a lively game of hide-and-seek round the corners of the building. Meantime the Indians and I, convulsed with laughter, threw ourselves down behind the largest boulders we could find lest the expected bullet might come our way. In a few minutes, however, Mr. Murray walked quietly back to his tent and the next morning discharged the offending Pilon.

Mr. Murray having been the first to survey and map the river now known as the Petewawé, gave it this name after an old Indian friend of his whose principal camping place was at the mouth of the river, and who was well known to all frequenters of old Fort William, which stood on the opposite side of the Ottawa.

Mount Logan, in the Shick Shock range in Gaspé, was so called at the suggestion of Mr. Murray, and he also gave the names they now bear to many of the geographical features in the country north of Lake Huron, which he was the first to lay down correctly on the map. He was an excellent surveyor and astronomical observer, as well as a neat and skillful draughtsman, as witnessed by the numerous large and well executed maps of his in the office of the Survey. Most of his surveys were plotted with his own hands, in the field. The numerous latitudes

which he took have been found of great service in fixing positions in many parts of old Canada and Newfoundland. His surveys of Lake Nipissing and the various channels of French River, made in several different years, were found sufficiently accurate for the purpose of the Ottawa Ship Canal Survey, and were adopted by the engineers of that project—Shanly, Clark, Perry, Norman and Galway—who gave him credit for the use they had made of them.

In 1842 the Geological Survey of Canada was instituted by the government, on a petition of the Natural History Society of Montreal, made at the suggestion of the late Rev. Dr. Mathieson. Mr. (afterwards) Sir W. E. Logan was appointed provincial geologist, but owing to unfulfilled business engagements in England he asked for leave of absence and spent the winter of 1842–43 in the old country. Here he appears to have first met with the subject of our sketch in the beginning of 1843, and to have engaged him as his assistant. Little is known of Murray's early studies as a geologist, but even when a midshipman he appears to have had a taste for the science, and had some practical training under Sir Henry T. De la Beche, with whom he served on the Geological Survey of Great Britain during 1841; while his nautical education had already fitted him to undertake topographical surveying. He arrived in Canada in May, 1843, and immediately commenced operations in the western province, while Logan returned from England, by Halifax, the same spring. On his arrival the latter proceeded to the north-western part of Nova Scotia and measured the celebrated section of the Carboniferous rocks at the Joggins, near the head of the Bay of Fundy, which is published in detail in the Report of Progress for 1843. He then went to the eastern part of Gaspé and examined the coast in detail from Cape Rosier to Paspebiac. This was the commencement of the Geological Survey, which has since been extended to nearly all parts of the northern half of the continent.

Murray wrote little for publication besides his official reports to the governments of Canada and Newfoundland.

When the Royal Society of Canada was founded by the Marquis of Lorne, it was made to include Newfoundland, and Murray was appointed one of the original Fellows. In 1882 he contributed to its Transactions an interesting paper on "The Glaciation of Newfoundland." He was elected a Fellow of the Geological Society of London in 1870, and in 1878 was created a C.M.G. through the recommendation of Sir John Glover, then Governor of Newfoundland.

When Logan and Murray commenced the Geological Survey of old Canada the greater part of the areas of both provinces were uninhabited, unsurveyed and unknown. The problem before them was to ascertain the general geological structure and the geographical distribution of the rock-formations, in spite of these difficulties. The region was so vast that it required some courage for two men to undertake this task. It was impossible for them to map out the rocks without making their own topographical surveys simultaneously with the geological ones. They could only do this by following the rivers and lakes through the forests and mapping them out as they went along. These surveys have subsequently proved to be wonderfully accurate, considering the difficulties under which our pioneers had to labor, and ever since they were made they have been found to be of the greatest service, even up to the present time; and, as topographical surveys alone, they have repaid many times over their small original cost.

But in addition to much of this kind of work, Murray made regional geological surveys of a considerable area on the north side of the North Channel of Lake Huron, of the area south and west of a line from Kingston to Penetanguishene, including the lake peninsula of Upper Canada, and of the country between the St. Lawrence and Ottawa rivers, as far west as a line from Kingston to Bytown. Besides assisting Logan in exploring parts of the north shore of Lake Superior, Murray's own work on that lake consisted of surveys of the Kaministiquia River, Dog Lake and River, Michipicoten River and Batchawana Bay, and also an examination of the south shore as far west as

L'Anse and Limestone Mountain, with a view to correlate the rocks of the two sides.

His topographical and geological surveys in the country directly north of Lake Huron embraced a greater or less portion of the course of each of the following rivers: Echo, Garden, Thessalon, Mississagi, Serpent, Blind, Spanish, Whitefish, Wahnapitæ, Sturgeon and Maskinongé; also Lake Wahnapitæ and numerous lakes connected with the Thessalon, Mississagi, Blind and Maskinongé Rivers. Between Georgian Bay and the Ottawa, he surveyed most of the numerous channels of the French River, the Sturgeon, Meganatawan, Muskoka, Petewawé, Bonnechere, southwest branch of the Madawaska, and the head waters of the Ottonabee Rivers and many lakes connected with them, including Lake Nipissing and Muskoka Lake. In Lower Canada he surveyed the Bonaventure, St. John or Douglastown, Matane and Ste. Anne des Monts, and assisted Logan (in 1844) to measure a traverse from the St. Lawrence to Baie de Chaleur by way of the Chatte and Cascapedia Rivers. During the season of 1849 he was again with Logan in making a geological survey of the region between the Chaudière River and the Temiscouata Road.

The early finding of nickel ore on the north shore of Lake Huron is worth referring to in connection with Mr. Murray's work and the subsequent discoveries of this metal in such abundance in the Sudbury District. In 1848 Murray examined the Wallace Mine, near the mouth of Whitefish River, where the initial discovery was made and which had been opened the previous year. The ore which he brought to the laboratory of the Survey at that time was found to contain 8·26 per cent. of nickel, "but as two fifths of the specimen consisted of earthy materials which might readily be separated by dressing, the quantity of nickel in the pure ore which this would represent, would equal nearly 14 per cent." The country rocks of the Wallace Mine belong to the same part of the Huronian system as those in the vicinity of Sudbury Junction, which lies on their general strike to the north-eastward.

A preliminary geological reconnaisance of parts of Newfoundland was made by Prof. J. B. Jukes in 1839–40, and his results were contained in his Physical Geography and Geology of Newfoundland, published in London in 1841. In 1862 Mr. James Richardson made a geological examination of the northern peninsula of the island from Canada Bay on the east side to Bonne Bay on the west, in connection with the Canadian Survey. I am indebted to Mr. James P. Howley the present government geologist of Newfoundland for the following notes on the origin of the regular Geological Survey which is still in operation. In 1862 or '63, Hon. James Rogerson, a member of the government, when on a visit to New York, had a conversation with the Hon. Mr. Archibald, the British consul general there, as to the mineral resources of the colony, when the latter recommended the institution of a geological survey and gave Mr. Rogerson a letter of introduction to Sir William Logan. He afterwards met Sir William, who entered warmly into the proposal and offered to send Mr. Murray to undertake the work. Mr. Rogerson communicated with Hon. Mr. (afterwards Sir) Hugh W. Hoyles, attorney general and premier of the island, who completed arrangements and obtained a grant of money from the legislature for beginning operations. The survey was under the honorary general direction of Sir W. E. Logan. Mr. E. Billings, palæontologist and Dr. T. Sterry Hunt, chemist and mineralogist of the Canadian Geological Survey gave Mr. Murray valuable assistance gratuitously from time to time.

Mr. Murray left Montreal on the 18th of May, 1864, with Mr. H. H. Beckett, as assistant, in order to enter upon his new duties. On his arrival at St. John's, he received more detailed instructions from Attorney General Hoyles and soon after commenced his field work, going first to the north-eastern side of the island. The next two seasons were devoted to the coast and interior of the western side. In 1867 Murray went to Paris to place a collection of the economic minerals of Newfoundland in the Universal Exposition which was being held there. An account of the

mineral resources of Newfoundland, addressed to Mr. W. C. Sargeaunt of London, then Crown Agent for the colonies, was published in the journal of the Society of Arts for 11th October, 1867. Returning to Newfoundland in August, he spent the remainder of the season examining Tilt Cove Mine and the surrounding country. While jumping from block to block in crossing a talus under one of the cliffs near Cape St. George early in the summer of 1866, he broke the tendon-Achilles of one of his legs, but in spite of this serious accident he continued his field-work for the remainder of the season, thereby preventing a satisfactory healing afterwards and he became lame for the rest of his life.

In 1868, Mr. James P. Howley was appointed assistant geologist. During this and the next two years, the attention of both Murray and Howley was directed to the eastern part of the island. In April 1869, Murray came to Montreal to visit Sir William Logan and on his return to Newfoundland he examined the copper deposits of Bonavista Bay, surveyed Terra Nova River and made a preliminary examination of Bay East River.

Surveys of the Exploits, the largest river in Newfoundland and of Red Indian Lake were made by Murray in 1871, while Mr. Howley was examining the shores of Exploits and Gander Bays. Sir Wm. Logan visited Murray in May of this year on his way from England to Montreal and spent about three weeks with him at his home in St. John's. Murray devoted most of the year 1872 to equipping a small geological museum in St. John's and arranging his specimens in it and also to preparing a general geological map of the island which was reduced by the late Mr. Robert Barlow to a scale of 25 miles to the inch. This map was engraved by E. Stanford of London and issued in 1873. His field work this year was confined to the peninsula of Avalon and a portion of the shores of Trinity Bay.

The summer of 1873, was devoted to ascertaining the extent and possible productiveness of the coal-field of Bay St. George. In connection with this work, Murray traced

out the distribution of the Carboniferous rocks in that region and also of the Silurian strata in the northern part of the same district. In 1874, he surveyed Gander River and Lake, while Mr. Howley surveyed Port-a-Port Bay and part of Bay St. George. His report accompanies that of Mr. Murray, who speaks of it in the highest terms. Before starting to the field this year, Mr. Murray paid a visit to Sir William Logan in Montreal. In a characteristic letter to Mrs. Murray, dated 8th May, he says: "Here I am at my old quarters and am charmed beyond expression to have to tell you that my dear old friend is very much improved in health and will, I fondly hope, be spared to us for a long time to come. That he has considerably failed there can be no manner of doubt, but the old stuff is strong in him yet and what between a noble constitution and indomitable pluck, I hope he may even last as long as old Bennett! The prospect of having me with him, I am told cheered him very much; and since my arrival he has apparently so much recovered as to be very much like what he ever was. ......Yesterday we walked in together and were busy all day going over the museum, new offices and one thing and another till time to return to dinner......I find myself so much made of here that I don't know how I shall get through all I have to do......I am getting, however, every kind of assistance in the meantime and I am made to feel while here at least, that I am one of themselves."

From this time till 1880, Mr. Murray continued to do more or less field-work each season, except in 1875, when he says his services were "required by the government for special purposes not immediately connected with geological investigations." Mr. Howley appears to have been in the field every season till 1883. In this year, owing to ill health, Mr. Murray was retired upon full pay and Mr. Howley was employed till 1887, in making land surveys for the government. Geological work was resumed in the latter year and is still continued under Mr. Howley, who is assisted by Mr. Bayly and Mr. Thorburn.

Mr. Murray's annual reports, which were never very

voluminous, were published year by year in St. John's, and some of them were reprinted in Montreal. When Mr. Howley made reports on the work assigned to him these were also published along with Mr. Murray's. On Murray's retirement from the direction of the Newfoundland Survey, he went to live at his native town of Crieff in Scotland. He had previously revised his annual reports and in 1881, he republished them at his own expense in one volume, through Ed. Stanford of Charing Cross, London, along with a large orographical map of Newfoundland(65 x 58 inches).

The space at our disposal will scarcely permit of even a brief summary of the scientific results of the Geological Survey of Newfoundland, which are clearly set forth in the official reports. They include the blocking out of the distribution of the rock-formations over the whole island and the tracing of them in more detail in certain areas where they were of most interest either scientifically or economically, such as on the west coast from Cape Ray to Bonne Bay, on the south side of Notre-Dame Bay and around some of the bays in the eastern part of the island. The greater part of the interior has been shown to consist of Laurentian and Huronian rocks. Cambrian strata fringe all the great bays in the east and occupy a large area between Trinity and Bonavista Bays. Cambrian and Silurian formations are developed all along the west coast and also at the head of White Bay on the north side, and small patches of Devonian sandstones, etc., were identified between Canada and Hare Bays north of White Bay. The Carboniferous rocks with thin seams of coal around Bay St. George and the north end of Grand Pond were carefully mapped out.

The general strike of all the formations throughout the island is north-easterly and south-westerly. The Upper Laurentian with crystalline limestones and titaniferous iron ones forms the western flank of the Long Range (of mountains) lying eastward of Bay St. George. Elongated areas of granites and greenstones occur among the crystalline rocks in various parts, all having the same general

run as the stratified masses. Serpentines were found to be largely developed in different regions, among which may be mentioned the west coast from Port-a-Port Bay northward more than half the distance to the Strait of Belle Isle, around Hare Bay near the northern extremity, Notre-Dame Bay and the head waters of the main Gander River.

The Cambrian and Lower Silurian formations are so well displayed and so rich in fossils that Mr. Howley thinks among them will be found the solution of certain problems in the geology of eastern north America. He is of opinion that the serpentines form two distinct groups, one belonging to the Cambrian or Silurian and the other to the crystalline series.

Before any Cambrian fossils had been discovered in Newfoundland, Mr. Murray, was led to believe, from other considerations, that certain rocks in the eastern part of the island belonged to that system and after much search he found a few at Bell Island and around Trinity Bay, which were described by Mr. Billings in his Palæozoic Fossils, Vol., II. Part I, and in the Canadian Naturalist, new series Vol. VI, July, 1872. In the summer of 1874, Sir Wm. Logan sent Mr. T. C. Weston, a lynx-eyed collector on the Canadian survey, to find more fossils among these rocks. He discovered them in abundance in the banks and on a small island in Manuel's River and also at Bell Island and Topsail Head, all in Conception Bay. These localities have since been visited by Prof. C. D. Walcott and described in his "Correlation Papers-Cambrian," which constitutes Bulletin 81 of the U. S. Geological Survey.

The original work that Mr. Murray performed in Newfoundland during the twenty years which he devoted to it were of more service in making the island favourably known to the outside world than anything which had previously occurred. The economic results of the Geological Survey have been very important. Before it was commenced the interior of the island was unknown, even geographically, and the great value of its mineral, timber and agricultural resources was unsuspected. The fisheries were

supposed to be the only source of wealth and the interests of the mercantile class were opposed to the development of any others. At first Mr. Murray's reports, pointing out the other riches of the island, were received with incredulity, but after a time there was a reaction in the opposite direction and a mania for mining and prospecting set in. Copper was successfully mined in large quantities in several places, but many speculative enterprises failed, and blame was unreasonably cast upon the Survey. The information contained in Mr. Murray's reports in regard to the timber led to the carrying on of lumbering operations in several quarters. These reports also showed the existence of considerable areas of cultivatable land around Bay St. George, and in the valleys of the Humber, Exploits and Gander rivers and more serious attention has since been paid to the agricultural capabilities of the colony. All this has given the people new ideas and has led to great changes in the positions of classes. The affairs of the colony are no longer controlled entirely by the merchants, nor do the working men depend so exclusively as formerly upon the fisheries. Other industries are springing up and a railway is being built across the island.

Before closing this brief sketch of the late Alexander Murray, we must say a few words about his domestic life in Newfoundland. After having been a widower for six years, he married Miss Elizabeth Cummins on 28th January, 1868. Five children were born of this marriage, namely, Mary Isabella Logan, 24th March, '69; Frances Augusta, 30th December, '70; William Edmond Logan, 11th September, '72; Alice Oliphant, 17th August, '74, and Alexander Greene, 3rd January, '76. Sir Wm. Logan left £1,000 stg. for the benefit of the eldest son who had been named after him. Murray was greatly pained when he heard the news of the death of his old chief and life-long friend to whom he was much attached, and he wept like a child.

As before remarked, he was created a C.M.G. in 1874. He acted as aide-de-camp to Sir John Glover, Sir Henry Maxse and Sir Frederick Carter, respectively, while these gentle-

men were Governors of Newfoundland. He was highly respected by all members of the different governments under which he served, and was most kindly supported by his brother officials who reciprocated his obliging disposition and good will.

Having, while in Canada, been thrown so much into contact with the Aborigines, and knowing their character, he became the great friend of the Indians of Newfoundland, some of whom served him for as many as fourteen years. They are said to speak of him yet as the best hearted man that ever lived. His house was their home in St. John's, and the photographs of Murray and his family are to be seen in all their wigwams, where they are highly prized.

While living in St. John's his manner was very unobtrusive and he appeared to care little for any society but that of his wife and family. Latterly he became a member of the Church of England and appears to have manifested a simple Christian piety. He enjoyed his full pay from the Newfoundland Government to the close of his life, but no pension was granted to his family, who were left ill-provided for, and would have fared badly but for the great and continued generosity of Sir Patrick Keith Murray and the present Laird of Dollarie, Mr. Anthony Murray, mentioned in a previous part of this article.

Notes and Descriptions of Some New or Hitherto Unrecorded Species of Fossils from the Cambro-Silurian (Ordovician) Rocks of the Province of Quebec. [1]

By Henry M. Ami, M. A., F. G. S.

BRYOZOA.

Solenopora compacta, Billings, var. minuta, N. var.

Zoarium, consisting of small globular or irregularly shaped masses which are apparently amorphous and com-

[1] N.B.—Throughout the text, the terms, *cell*, *interstitial cell*, *zoecium*, *spiniform tubuli*, etc., have been used by the writer in order to be uniform with the terminology employed by Mr. Foord, in his "Contributions to the Micro-Palæontology

pact to the naked eye, but exhibit under a microscope the typical and characteristic structure of the genus Solenopora (Dybowski). One of the specimens measures 5-40ths. of an inch in height and 15-40ths. of an inch in diameter, in the direction of the section which is cut partly at right angles to the tubes and partly in direction of the tubes *i. e*, parallel to them.

The species evidently belongs to the genus of which *Solenopora compacta*, Billings, is the type, and is almost identical with it. The tubes or zoœcia, however, are more closely arranged and more numerous, being proportionally smaller in the Quebec specimens than in the typical examples from the lower beds of the Trenton formation of other portions of Canada. The tubes in the examples from Quebec also appear to be more tortuous, and at times resemble the structure observed in such forms as *Girvanella* or *Strephochetus*. Of the genus *Solenopora*, there appear to be two, and perhaps three distinct forms from the Cambro-Silurian or Ordovician strata of Canada.

1. One of these, the typical *Solenopora compacta*, Billings, sp. (=Stromatopora compacta, Billings; =Stenopora compacta, Dawson; =Tetradium Peachii, Nich. and Etheridge; =Solenopora spongioides, Dybowski; =Tetradium Peachii, var. Canadense, Foord; (Cymatopora compacta, Dwight, M.S.S.) occurs in abundance through a considerable thickness of the lower beds of the Trenton of Ontario and Quebec, and has zoœcia varying from 1-320 th. to 1-400 th. of an inch in diameter, whilst the Scotch representative described by Dr. Nicholson and Mr. Etheridge, jr., has zoœcia which measure 1-420 th. of an inch—" one-thirty-fifth of a line "—in diameter.

2. A second species of this genus *Solenopora*, occurs in the limestones of the Bird's Eye and Black River formation at Paquette's Rapids, on the Ottawa River. This locality is referred to by Billings as one of the places where this

of the Cambro-Silurian rocks of Canada," 1883. I very much prefer the terms "*autopores*," "*mesopores*," "*acanthopores*," etc., now employed by Messrs. Foord, Ulrich and other authors.

Stromatopora (now Solenopora) *compacta* could be found, and gives no figure nor microscopic characters whereby the species may be recognized. Now that *Solenopora compacta*, Billings sp., is a well established species which finds place in the nomenclature of present writers, it appears from an examination of microscopic sections of the Paquette Rapids form, that it is distinct from the ordinary form and is readily distinguished therefrom by the large size of its zoœcia—they vary from 160 to 200 in the space of one inch, *i. e.*, each zoœcium varies from 1-160th. to 1-200th. of an inch in diameter. The specific name *Solenopora Paquettiana*, is here proposed to receive such forms as this which present the generic characters of the genus Solenopora, but have zoœcia or tubes much larger than in *S. compacta*, and also less wavy. The zoarium is also considerably larger than ordinary specimens of *S. compacta.* No diaphragms have been detected in the longitudinal section of this form. There must obviously have been diaphragms at more or less regular intervals in the tubes, but, as in most specimens of *S. compacta*, they are not evident. Very skilfully prepared sections of especially well preserved examples from the Trenton rocks of Poughkeepsie, N. Y., kindly presented to the writer by Prof. W. B. Dwight, of Vassar College, have revealed the tabulæ of *S. compacta.*

3. The third form occurs in the hard compact cherty limestone rocks of Quebec city at Côte d'Abraham, and closely resembles the type species *S. compacta*, but is clearly distinct from *S. Paquettiana*, both from the size and regularity of its tubes. From *S. compacta*, the Quebec variety '*minuta*,' differs in having smaller zoœcia, less regularly arranged and often very tortuous. There are from 480 to nearly 600 tubes in the space of one inch, and these are all in close contact. No septal teeth or spiniform projections from the wall inwardly have been detected in any of the zoœcia, which are irregularly rounded polygonal and triangular at times.

Under the microscope this form, *S. compacta*, var. *minuta*,

may be readily distinguished from the other two species, and on this account has had the varietal designation affixed.

Locality.—Côte d'Abraham, Quebec City, Quebec.

Collectors.—H. M. A. and N. J. Giroux, 1888.

Micro Sections.—2,110 and 2,115. Prepared by Mr. T. C. Weston.

DICRANOPORA PARVA, N. SP.

Length of the only specimen (fragment) examined: ·175 inch; breadth, ·05 of an inch. There are from six to eight rows of cells across the polypary which are obliquely disposed in lines, so as to give to the zoærium a quincunxial arrangement which is characteristic and evident. Between the cell apertures, whose margins are somewhat thickened, are seen low depressed and indistinct lines which give a slightly longitudinal aspect to the rows of cells, besides the oblique or quincunxial disposition. This form appears to be distinct from those described by Mr. Ulrich from the Cincinnati group of Ohio, and the name *D. parva* is here suggested for this form.

Locality.—Gagnon's Beach, near the boundary between Matanne and McNider Townships, Quebec.

Collector.—T. C. Weston, 1887.

PRASOPORA LYCOPERDON, Vanuxem var. SELWYNI, N. VAR.

Zoarium sub-hemispherical, massive, about half an inch in diameter and the same dimension in height; tubes erect, prismatic.

Tangential or cross-section. This section exhibits the characters and general features of the genus *Prasopora*, Nich. and Ether, jr. The zoœcia are polygonal however, and in close contact with one another, there being only an occasional interstitial cell developed between the zoœcia. This almost total absence of interstitial cells, so prominent and characteristic in typical examples of *Prasopora lycoperdon*, Vanuxem, (=P. Selwyni, Nicholson), from the Trenton formation of Canada and the United States, differentiate the Quebec species or variety from the typical species.

Longitudinal section. This section shows the characters of *P. lycoperdon*, save the smaller or interstitial cells with closely arranged tabulæ which appear to be wanting. The curious oblique funnel-shaped or invaginating diaphragms with tabulæ developed in them at different heights, are exceedingly striking and characteristic; some of the zoœcia present horizontal and straight diaphragms from wall to wall. There are about 72 zoœcia in the space of one inch, or each zoæcium is ·0138 inch in diameter. In this character this variety comes closer to the smallest representatives of the type (*P. lycoperdon* Vanuxem or *P. Selwyni* of Nicholson), which are 1-70th of an inch in diameter.

Locality.—In the hard cherty limestone bands of Côte d'Abraham, Quebec City, Quebec.

Collectors.—H. M. A. and N. J. Giroux, 1888.

Micro sections.—Nos. 2,107, 2,108, 2,109, 2,116. Prepared by Mr. T. C. Weston.

DIPLOTRYPA QUEBECENSIS, N. SP.

Zoarium sub-hemispherical, base concave, height about two lines, diameter about half an inch.

Tangential or cross section. Zoœcia about 1-60 th. inch in diameter, varying from 1-50 th. to 1-75 th. of an inch. In shape, the zoœcia are polygonal, but often circular, mostly in contact, but at times one zoœcium is almost completely isolated by the presence of interstitial cells, which are developed throughout the zoarium but in greater number in certain portions of it. The interstitial cells vary considerably in shape, size and distribution, being often triangular, hour-glass shaped, and four, five, and even six sided at other times. No spiniform tubuli are seen in this section.

Vertical or longitudinal section. The tubes are perpendicular to the base of the zoarium and regularly disposed. The walls are comparatively thick, and especially in the upper portion of the zoarium. The zoœcia have a few distinct horizontal or slightly curved tubulæ or diaphragms, whilst

the interstitial cells have more numerous and horizontal diaphragms developed.

NOTE. The paucity of tubuli in the specimen examined may be due to its state of preservation or fossilization, as the few that are seen in the zoœcia are only faintly visible in the coarsely crystalline calcite which fills the tube. No spiniform tubuli are seen in this section.

This species is most nearly related to *Diplotrypa Milleri*, Ulrich, but differs therefrom in possessing much fewer diaphragms, both in the zoœcia and in the interstitial cells.

It differs also from *D. Whiteavesii*, Nicholson, *D. Petropolitana*, Pander, *D. regularis*, Foord, and *D. infida*, Ulrich, in possessing no spiniform tubuli.

Locality.—In the hard calcareous beds of Côte d'Abraham, Quebec City

Collectors.—H. M. A. and N. J. Giroux, 1888.

Micro sections.—2,113. Also prepared by Mr. T. C. Weston.

MONOTRYPA INCERTA, N. SP.

Zoarium, small, sub-cylindrical or irregularly elongate sub-spherical, height, ·25 inch ; longer diameter, ·375 inch ; shorter diameter, ·25 inch.

Tangential section. In tangential sections, the zoœcia are seen. to be regularly polygonal of uniform size, and apparently of one kind only. The walls around each are clearly visible and are only moderately thickened. Occasionally a smaller zoœcium is developed between the larger ones, but appears to be only an immature zoœcium and differs in no respect from the larger or proper zoœcia. There are no interstitial cells at all. The other generic characters are also evident.

Longitudinal section. This section exhibits the uniform prismatic character and regular size of the tubes. Diaphragms are tolerably numerous and straight, whilst at times they have a decided curvature. These are distant from each other one tube diameter or thereabouts.

The zoœcia are ·0156 inch in diameter, or number 64 in the space of one inch, as measured both in the tangential and longitudinal sections.

Locality.—In the hard compact cherty beds of limestone of Côte d'Abraham, City of Quebec, Quebec.

Collectors.—H. M. A. and N. J. Giroux, 1888.

Micro sections.—2,111, 2,112 and 2,114. Prepared by Mr. T. C. Weston.

DOUBTFUL SPECIES.

Besides the foregoing species of Monticuliporidæ and Bryozoa which were obtained from the hard calcareous band of Côte d'Abraham, Quebec, there occur in addition, two forms whose generic and specific affinities are still doubtful, since the material from which Mr. Weston prepared the microscopic slides which contains both is somewhat imperfect and poorly preserved, most of the structure of one polypary having been obliterated in the one, and in the other case the matrix is very granular, which fact gives a granular and obscure aspect to the organism. The specimen from which the slide was prepared, was obtained also from Côte d'Abraham, Quebec, and the number of the slide or section is 2,117. For reference sake the two forms are designated A. and B. respectively.

FORM A.

GENUS ? — SPECIES — ?

This form consists of a small, narrowly cylindrical or slightly flattened polypary, with one row of rather deeply and obliquely situate cells on each side of the median axis or line which separates the zoarium into two parts. The zoarium measures seven-sixtieths (·116) of an inch in diameter, whilst the width of the zoœcia or tubes at their aperture measures less than 1-100th. of an inch in diameter. The polypary is obtusely rounded at one extremity—the distal extremity of the zoarium—and the cells are inclined at an angle of about 45° to the median axis. No evidence of tubulæ or diaphragms of any sort have been observed in the section. The microscopic section shows the skeletal parts of the polypary to be fibrous in structure. In a general way, this form appears to belong to the family of *Ptilodictyonidæ*, but its generic and specific affinities are still unknown.

FORM B.

GENUS ? — SPECIES ? —

This form consists of small sphæroidal or irregularly shaped masses which present an exceedingly minute, yet recognisable radiating tube-like structure with faint indications of concentric lines. The zoarium (?) appears to have certain affinities to the genus *Solenopora,* Dybowski, but differs therefrom in the size and distribution of the corallites (?) and in several other points. It has also been compared with *Girvanella* and allied forms, but although poorly preserved, shows salient characters of difference.

In examining and re-classifying the genera and species of Monticuliporoids in our collections, a similar form was observed in *Micro-section* 804, prepared by Mr. Weston from a specimen of Trenton limestone collected at Hull, Quebec, by Mr. W. R. Billings in 1882, alongside a species of *Heterotrypa,* probably *H. solitaria,* Ulrich, which designation Mr. A. H. Foord has attached to the slide holding the large polypary. Though more irregularly shaped in outline than the Quebec City specimen, the Hull one is evidently and easily seen to be congeneric and co-specific with it. Along the outer portion of the zoarium, the radiating tubes (?) or zoœcia (?) are more clearly visible, whilst the central portion is occupied by more or less regular (somewhat granular) network which resembles a reticulate structure. The diameter of the Quebec City specimen is ·0146 of an inch. The matrix in which both the Hull and the Quebec specimens are preserved, is such as to obliterate such a minute structure as the zoarium (?) evidently possessed. When found imbedded in a finer grained rock, the exact relations and true affinities of this interesting form will, it is hoped, be more definitely ascertained.

PALÆONTOLOGICAL NOTES.

By Henry M. Ami, M.A., F.G.S.

I.

On a Collection of Fossils from the Ordovician of Joliette, in the Province of Quebec.

In the "Geology of Canada" for 1863, Sir William Logan has given several interesting notes on the structural relations of the rocks about Joliette (or "Industry" as it is sometimes called,) and has also shown that the Chazy, the Bird's Eye and Black River as well as the Trenton terranes all occur there along the shores of L'Assomption River, whose rapid flowing stream affords magnificent water power for saw and carding mills, a foundry and an important paper factory.

These *three* Ordovician terranes are beautifully exposed along the cliffs and banks of L'Assomption River, from under and close to the mill above the 'upper bridge' to the 'old mill' or 'Vieux Moulin,' some two miles below the town. Some excellent building stone has been extracted and is still being quarried out, well adapted for railway bridges, piers and dwellings, whilst the more crystalline beds in the Desmarais quarries afford a superior quality of lime when burnt.

The Chazy.

The Chazy terrane is characterized by Sir William Logan as gradually thinning out in this section of Canada—being visible and estimated at a thickness of some *thirty* feet only—and holding a fossil which Mr. Billings recognised as the *Pleurotomaria staminea*, of Hall—now better known as a *Raphistoma*, *R. staminea*, Hall, sp.

This species is eminently characteristic of the Chazy in many parts of Canada and the United States—so that its presence leaves no doubt as to the occurrence of the Chazy at Joliette. It is hoped that future investigations will afford more ample material wherewith to describe this most interesting series which gradually dies out a little farther

east and reappears some 500 miles down the St. Lawrence—at the Mingan Islands, north of Anticosti.

The Bird's Eye and Black River.

The Bird's Eye and Black River terrane of Joliette consists of *fifty* feet of limestone holding the well known and typical fossil corals, viz: *Columnaria Halli*, Nicholson, and *Tetradium fibratum*, Safford. These fifty feet of strata form the base of Sir William Logan's Trenton in this district whose total thickness he estimated at 480 feet.

The Trenton.

During the summer of 1881 the writer had an opportunity afforded him of examining the beautiful exposures of this highly fossiliferous terrane along the banks of L'Assomption River for a distance of some three miles, and obtained quite an interesting suite of specimens which it is proposed to place on record in this paper.

No Trenton fossils are described or referred to by Sir Wm. Logan in the volume cited above.

The Trenton, however, is therein described and subdivided into three sections in descending order as follows:—

	Feet.
(*a.*)—Evenly bedded and dark coloured limestone	200
(*b.*)—Nodular limestone	140
(*c.*)—Gray coloured limestone	90
Total	430

From a collection made at "Industry Village," in 1852, by Sir William Logan, the following forms have been determined by the writer:

1. *Strophomena alternata*, Conrad.
2. *Leptæna sericea*, Sowerby.
3. *Orthis testudinaria*, Dalman.
4. *Asaphus Canadensis*, Chapman.

It would thus appear from the above list that we have here strong evidence for the presence of the upper beds of the Trenton with the probable existence of the Utica terrane. The occurrence of *Asaphus Canadensis*, Chapman, indicates close proximity to the Utica, if not indeed the

actual presence of that terrane. These facts, therefore, point to a higher horizon than had hitherto been indicated in the "Geology of Canada" above cited.

The following list of Trenton fossils is based upon the collection made by the writer in 1881—at the quarries near the "Pont des Dalles"—and at the old mill, some two miles down the river below this bridge. As can be readily seen they are eminently characteristic species. I have no doubt that this list could be swollen to larger proportions as the rocks are highly fossiliferous and the specimens in a very good state of preservation.

The occurrence of orthoceratites several feet in length and in abundance, and of beautifully preserved and large specimens of *Conularia Trentonensis* is especially worthy of note.

List of Trenton Fossils from Joliette, Que.

1. *Diplograptus cf. D. putillus*, Hall.
2. *Solenopora compacta*, Billings, sp.
3. *Stictopora acuta*, Hall.
4. " *sp. indt.*
5. *Ptilodictya maculata*, Ulrich.
6. *Monotrypella Trentonensis*, Nicholson.
7. *Prasopora lycoperdon*, Vanuxem.
8. *Amplexopora Canadensis*, Foord.
9. *Serpulites dissolutus*, Billings.
10. *Glyptocrinus ramulosus*, Billings.
11. *Orthis plicatella*, Conrad.
12. " *testudinaria*, Dalman.
13. *Strophomena alternata*, Conrad.
14. *Leptæna sericea*, Sowerby.
15. *Conularia Trentonensis*, Hall.
16. *Cyclonema bilix*, Hall.
17. *Trochonema umbilicatum*, Hall.
18. *Pleurotomaria Progne*, Billings.
19. *Endoceras proteiforme*, Hall.
20. " *multitubulatum*, Hall.
21. *Calymene seneria*, Conrad.

22. *Asaphus platycephalus*, Stokes.
23. *Illænus cf. I. Milleri*, Billings.
24. *Ceraurus pleurexanthemus*, Green.

NOTE.—The strata in the neighbourhood of the rapids and falls below the town point to the existence of local faulting or dislocations, as they are considerably disturbed and are seen to dip to as high an angle as 60° to the S.W. L'Assomption River is one of those post-tertiary streams which is fast cutting its way through the Leda clay and Saxicava sand terranes, as also through the uppermost members of the Cambro-Silurian or Ordovician system in the higher levels.

II.

ON THE OCCURRENCE OF FOSSIL REMAINS ON THE MANITOU ISLANDS, LAKE NIPISSING, ONTARIO.

The Manitou Islands—which form a group of six beautiful Islands—are pleasantly situated in the basin of Lake Nipissing, Ontario, and are easily reached by way of North Bay, an important railway centre along the line of the Canadian Pacific Railway. Whilst the shores of Lake Nipissing are completely made up of Archæan rocks, these islands are seen to consist at several points of sedimentary strata which when examined are found to be rich in fossil remains and indicate with tolerable precision the horizon or period when these strata were laid down.

The occurrence of *Tetradium fibratum*, Safford; *Columnaria Halli*, Nicholson; *Ormoceras Bigsbyi*, Stokes, and an obscure specimen of *Goniceras anceps*, Hall, suggest the natural inference that the limestone beds of these islands belong to the Black River formation.

The early, and, perhaps, only record of fossiliferous limestones on these islands "holding Orthoceras with a few obscure fossils" may be found in Alex. Murray's report to Sir Wm. Logan for the year 1854 [1] "*Ormoceras tenuifilum* of Hall" is therein noted with considerable certainty and

[1] Report of Progress, Geol. Surv. Can. 1853-54 55-56, p. 124.

the strata consequently referred to the Black River formation.

The collection upon which the following list of species of fossils is based, was made in the summer of 1884 by Dr. A. R C. Selwyn who was assisted by Mr. H. P. Brumell. They comprise seventeen species of Ordovician fossils characteristic of the Black River formation as follows:—

LIST OF SPECIES.

1. *Columnaria Halli*, Nicholson.
2. *Tetradium fibratum*, Safford.
3. ? *Coscinium proavium*, Eichwald.
4. *Stictopora acuta*, Hall.
5. *Ptilodictya recta*, Hall.
6. *Amplexopora Canadensis*, Foord.
7. 8. Several species of *Monticuliporidæ*.
9. *Streptorhynchus filitextum*, Hall.
10. *Rhynchonella increbescens*, Hall.
11. *Ecculiomphalus Trentonensis*, (?) Conrad
12. *Pleurotomaria subconica*, Hall.
13. *Ormoceras Bigsbyi*, Stokes.
14. " (?) *fusiforme*, Hall.
15. *Endoceras multitubulatum* (?) Hall.
    (= *Vaginoceras multitubulatum*, *H. sp.*)
16. *Endoceras proteiforme*, Hall.
17. (?) *Gonioceras anceps*, Hall.

Note.—The Rev. J. M. Goodwillie, M.A., who resided in North Bay some years has just informed me that he has made an extensive collection of fossil remains from these islands, so that additional forms will doubtless be found when the collection is examined.

OTTAWA, Feb. 1892.

THE PHYSICAL FEATURES OF THE ENVIRONS OF KINGSTON, ONT., AND THEIR HISTORY.

BY A. T. DRUMMOND.

Two years ago, when revisiting for three months the scenes of my earlier years at Kingston, the opportunity occurred again of examining, hammer in hand, the Lauren-

tian ridges, the limestone escarpments, and the picturesque islands which contribute so much to the variety of the landscape in the neighbourhood of the city, as well as make its environs so geologically interesting. When a student at Queen's, I had gone over the ground, occasionally with Dr. Geo. Lawson, now of Dalhousie College, Halifax, but then of Queen's, sometimes with the late Dr. John Bell, of Montreal, who was an enthusiastic botanist, and often, alone, and as the familiar spots, one after another, came, after long years of absence, once more to view, many a pleasant memory of extended rambles and of interesting discoveries was recalled. The geological notes then made when a student have not been published, but some of them are still of interest and will be referred to here and be supplemented by the more recent notes.

Lying almost at the point of contact of the old Archæan rocks with those of the overlying Cambrian and Trenton, and in a section of country where the evidences of glacial action in quaternary times are very marked, besides being at the foot of Lake Ontario where the waters of the Great Lakes join the St. Lawrence amid the diversified features and scenery of the Thousand Islands, Kingston has much to interest the geologist. The city itself is, in reality, situated on what appears to have been an ancient island, whose length was about six miles with an extreme breadth of three miles, and whose boundaries, apart from the harbour front, are now well defined by the limestone escarpment, which, leaving the lake shore west of the Lunatic Asylum, skirts the broad valley of Little Cataraqui Creek some miles in a northerly and then north-easterly direction, until, veering around to the south-east as it approaches Kingston Mills, it meets Great Cataraqui Creek and then parallels it in its entry to the harbour at Kingston.

The harbour fronting Kingston is, in its main expanse, underlaid, probably throughout, by the Black River limestones, judging by the comparative uniformity of the soundings in the channel. The usual depth there is from

ten to twelve fathoms. Off Cedar Island the bottom may have suffered by the disturbances which affected the whole Laurentian area, as I have found there the greatest depth of the harbour—seventeen fathoms.

The precise area occupied by the palæozoic rocks in the environs of the city, and their age, have not hitherto been as accurately defined as is desirable, and a brief reference to these and the Laurentian rocks is necessary.

LAURENTIAN ROCKS.

The Laurentian rocks are met with in great masses at Kingston Mills, and thence eastward and north-westward, forming here and among the Thousand Islands the gneissic ridge, as it were, which connects the Laurentian areas of New York State with those of Canada. Nearer Kingston, these rocks appear on the summit of the Fort hill, on the banks of Haldimand Cove, and on Cedar and Milton Islands, in each case forming ridges which—as elsewhere among the Thousand Islands—lie in a general north-east and south-west direction. The Laurentian strata have been here elevated into these great ridges at a period subsequent to Black River times, as, on the Fort hill, the limestone strata are tilted up at a high angle on both sides of the steep ascent, and overlie the Laurentian from the base to almost the summit, which is crested with gneiss.[1] On the north side of Cedar Island the limestone strata are also seen near the water's edge in a similar but less tilted position. Again, there are not wanting some indications, near the granite quarries on the banks of Haldimand Cove, that the granitic rocks here are not earlier in age than the

[1] My friend, Mr. Frank D. Adams, informs me that at Lake St. John limestone rocks of lower Silurian age, with similar dips at their immediate contact with the sloping gneiss floor on which they were deposited, have been found by the Geological Survey officers in reality in their natural beds as deposited, the material having apparently rolled off, as it were, from the apex and lower down, and adjusted itself in sloping beds on the sides. In this instance at Kingston, however, the evidence of upheaval is distinct, and I am glad, since this paper has been put into type, to have the corroboration of so careful an observer as Prof. James Fowler, of Queen's University, Kingston, who writes that "the breaks in the strata and the dip towards the bridge on the one side and the river on the other, look as if the elevation took place after the Black River was laid down."

Black River, and are probably contemporaneous with the upheaval of the Laurentian strata.

POTSDAM SANDSTONE.

On the banks of the Rideau Canal the Potsdam sandstone is first met with about five or six miles to the eastward of Kingston Mills, and is here of suitable quality and in ample quantity for building stone. On the south side of Pittsburg, opposite Howe Island in the St. Lawrence between Kingston and Gananoque, and again at the lower end of that island, it is once more seen, whilst at Gananoque it forms the eastern bank of the ravine near the village and both banks of the river Gananoque immediately in the village. Judging from the soundings made by me, it, likewise, forms the bed of this stream and extends outwards some distance under the St. Lawrence. The stone is used with very good effect in Gananoque for building purposes. Hay Island, Tidds Island, part of Round Island, and the upper end of Wellesly Island at the Thousand Island Park, also belong to this formation. There are thus exposures of the Potsdam sandstone at intervals to within six miles of Alexandria Bay, and as the same rock reappears near there and continues again at intervals to Brockville, there is a probability that in earlier times it has had a very much more extensive development in the valley of the St. Lawrence here, possibly, originally, bridging over the present Laurentian break.

BLACK RIVER ROCKS.

The city of Kingston itself is underlaid by the Black River limestones, these in turn resting directly on the Laurentian strata, as is well illustrated on the Fort hill, Cedar Island, the banks of Haldimand Cove and elsewhere. These Black River strata, underlying and around the city, are somewhat deficient in fossils, and at the time of publication of Sir William Logan's General Report on the Geology of Canada in 1863, considerable doubt was entertained as to whether these rocks, in, at least, their lower portion, might not belong to an earlier epoch. My own

subsequent finding, however, of *Orthoceras rapax*, Bill, and some fragments of crinoidal columns in a deposit of somewhat disintegrated rock containing numerous silicified fragments of fossils and directly reposing on the Laurentian in a cutting of the Grand Trunk Railway at Kingston Mills, finally determined the late Mr. E. Billings, the palæontologist of the Geological Survey, to refer the strata to the Black River age. Those strata which rest directly on the Laurentian are generally, however, quite devoid of fossils, and not infrequently the lower layers have the appearance of a conglomerate, the imbedded material being small worn boulders of gneiss and quartzite from three inches to one foot in diameter, and numerous sharply angular pieces of quartz, chiefly of smaller size. On the north side of the Grand Trunk Railway track the limestones terminate west of Kingston Mills, but on the south side they extend in a partly covered escarpment about five miles farther eastward, and cover the intervening space thence to the St. Lawrence. Garden Island, and the greater portion of Howe, Wolfe, and, possibly, Simcoe Islands, are of Black River age.

TRENTON ROCKS.

At Cape Vincent, in New York State, opposite Wolfe Island, the limestones contain, amongst other life, *Calymene Blumenbachii*, Bron, and *Leptæna sericea*, Sow, which sufficiently indicate their Trenton origin. At Horse Shoe Island, at the head of Wolfe Island, about eight miles southwest of Kingston, and again at Collinsby, on the Grand Trunk Railway, the rocks apparently belong to the same epoch. Thus, if any actual distinction is to be retained in Canada between the Black River and Trenton epochs, a line drawn across the St. Lawrence through these localities would appear to about indicate where the Black River rocks are succeeded by the true Trenton.

QUATERNARY DEPOSITS.

From the period of the Trenton to that of the Quaternary, the environs of Kingston appear to have had a long rest

from the inroads of the water and from other disturbing influences, beyond the special elevation of the Laurentian ridges before referred to, and the general elevation of the whole country here and to the north-eastward, to admit of the necessary fall for the great glaciers of the glacial period. The traces left by quaternary forces are seen in the limestone escarpments at many points in the environs of the city; the broad river valleys now occupied by Little Cataraqui and Great Cataraqui Creeks; the ice grooves, visible in every direction, but developed on a magnificent scale, near the upper steamboat landing on Wolfe Island; the great deposits of sand at Cataraqui and elsewhere; and the Laurentian and other boulders scattered everywhere, even on the top of the Fort Hill, where the huge block of unworn Potsdam sandstone, half buried in the soil, is a conspicuous object.

Whilst the history of the site of the city and its environs during the vast ages which elapsed between the Trenton period and the close of the Tertiary, is almost a blank, yet, from the latter time, its history begins once more. Suggestions of great forces having been at work come, as we have seen, from all sides—from the lake bottom, the river valleys, the grooved rocks, the great stretches of escarpments, the scattered boulders. At the close of the Pliocene the Laurentian area in the townships to the northward and eastward was higher than it presently is, and circumstances seem to show that this elevation extended so far over the limestone area in the vicinity of Kingston that the lake shore at that time was probably outside of a line drawn from Stony Point, off Sacket's Harbour, to South Bay Point, in Prince Edward County. A rise of 100 feet would bring to the surface nearly the entire area presently under water between this limiting line and the city-excepting what would then form two inlets or river channels—the relicts, it may be, of two glaciers—the one on the west side of Duck Island and extending inwards towards Kingston to within three miles of the present Nine-mile Point Lighthouse, and the other on the east side of the

same island and extending in the direction of the present American channel in the St. Lawrence, and to within four miles of the south-west point of Wolfe's Island.

LAURENTIAN RIDGES.

At this time, also, the Laurentian ridges, which are so numerous in the rear townships, and are illustrated around Kingston in the elevations comprising Cedar Island, the Fort Hill, and the south side of Haldimand Cove, had already appeared. These ridges which in reality indicate, in their prevailing general north-east and south-west course, the direction taken by the vast internal forces which gave rise to their upheaval, have had much to do with giving the direction taken by the great glaciers of quaternary times, and have also shaped the original outline of many of the numerous lakes in the Laurentian country in the immediate rear of Kingston, however much the glaciers may have subsequently smoothed the roughness of this outline. The general course of the numerous elongated lakes lying here in the laps of these ridges, and near the border-land where the Laurentian and the higher formations meet, is a most pronounced north east and south-west, and I cannot think that their outline is to be attributed solely to softer strata having been worn away. It was rather that the ridges and intervening valleys gave the course to the glaciers, and, in that course, these valleys had their outlines smoothed and their depths somewhat deepened, and were thus prepared for their new position as the beds of lakes in the less elevated country of the present day. The lie of the lakes, in sections of the Laurentian country farther west, takes different directions—sometimes to the south-eastward and across the general line of glacial action—and it will, I suspect, be found, in such cases, that this lie of these lakes conforms to that of the ridges in the surrounding country.

ORIGIN OF THE ISLAND.

Following the elevation of the land and the incoming of the glacial period, came probably the first outlining of the

ancient island on which Kingston is situated. The present broad beds of Little Cataraqui and Great Cataraqui Creeks were gradually chiselled out, first by glaciers and then by the waters of what would then be two deep inlets from the lake and a river divided by the island, and thus the limestone escarpment which in large part forms the island's front was created. The sand deposits in the direction of Glenburnie, again at Cataraqui, and again in the estuary west of the Lunatic Asylum, would seem to indicate that the Little Cataraqui Creek valley was the channel down which the great body of the water from the Laurentian heights immediately beyond here came. The different beds of sand in the estuary also appear to mark three successive stages and conditions of deposit—the lowest, a coarse sand laid down in deeper water, the middle a strongly wave-marked bed, indicative of rapidly flowing waters, and the highest a deposit of fine silt-like sand, which has settled during comparatively still waters.

THE OUTLET OF LAKE ONTARIO.

Perhaps the most interesting questions are connected with the outlet of the waters of Lake Ontario into the St. Lawrence here. Have these waters since Ontario expanded from a river into a lake always flowed downwards to the ocean over the Laurentian ridge at the Thousand Islands? Presently there is a depression here between the Adirondacks of New York State and our Canadian Laurentian ridges sufficient to admit of this downward flow, but, between Kingston and Cape Vincent, it is a comparatively shallow depression. The lake is undoubtedly pre-glacial, but the somewhat higher elevation of the Laurentian area at the close of the Pliocene to admit of the descent of the glaciers, would make it probable that at this time, as well as during the melting and recession northward of the ice area, the outflow was by way of Lake Oneida and the Mohawk Valley. Even at the Park towards the centre of the Thousand Islands, the grooves in the sandstones lie S. 40° W., showing that there must have been some eleva-

tion in the heart of the Laurentian ridge there to admit of the necessary ice flow, not merely there but onwards to the south-westward over the ice-grooved limestones at Kingston and Wolfe Island. During the glacial epoch, and its inter-glacial periods, if any, here, the outlet was, the American geologists insist, so completely blocked with ice that the flow was necessarily by way of the Mohawk Valley to the ocean, but it does not seem requisite to assume that there was this ice blockade, as the already existing elevation probably formed a more than ample barrier to the lake waters.

If this view of Laurentian depression be correct, then the St. Lawrence, immediately before the commencement of the ice age, was a modest stream, taking its rise here in the Adirondacks or Canadian Laurentians and flowing towards the sea in very much the same course as now, for this course was not much altered by the subsequent ice flow north-eastward from the Laurentians. The river from Brockville, immediately above which the Laurentian ridges under the river disappear, downwards to the first rapid near Edwardsburg, has, on the whole, a considerable uniformity of depth in the channel, and flows through a low, comparatively level valley, unobstructed by islands. The river Ottawa, on the other hand, was, probably, at this time a much larger stream, as the great limestone escarpments and the terraces along its course seem to indicate. The oscillations of the earth's surface in eastern Ontario and in Quebec had led to its being at one time an arm of the sea, and at another, perhaps later time, a great river, which Mr. J. K. Gilbert even thinks found its rise in the Georgian Bay and drained the upper Great Lakes. During the ice age, and the subsequent Champlain times, the path of the icebergs and glaciers was, in a general sense, down the valley of the Ottawa, and this, no doubt, occasioned much of the wear of the strata in the river's course.

The oscillations in level over great stretches of country or local warpings of the strata, will explain many of the physical features of a district. Thus, around the outlet of

Lake Ontario there were changes of this character. A depression at the Thousand Islands, and a rise in level at the south-eastern end of Lake Ontario, led to a gradual change in the lake's outflow from the valley of the Mohawk to the valley of the St. Lawrence. This change took place in the Champlain era, and was probably contemporaneous with that condition of depression in Eastern Ontario and Quebec and that condition of flood and depression in the peninsula of Ontario west of the Thousand Islands, which has given us the sands and clays of the one section and the great areas of the clays in the other. Since then there have been further warpings of the surface, involving a rise from the Trent Valley westward and on the south and east sides of Lake Ontario. These disturbances have, in general terms, brought us to the order of things at the present day.

The Water Supply of the City of Kingston, Ontario.

By Prof. W. L. Goodwin, Queen's University, Kingston.

In the course of an inquiry into the water supply of Kingston, several facts of considerable interest have been made out. The objects of the investigation were principally:—

1. To ascertain the character of the well-waters used in the city,

2. To determine the degree of purity of the water supplied by the waterworks, and,

3. To make comparative tests between the waterworks supply and the water of Lake Ontario at various points near Kingston.

In the course of this investigation it was found advisable to discover approximately the direction of the harbour and lake currents, and to obtain data regarding temperatures at various depths.

Wells.

Kingston is unfavourably situated for obtaining good water by means of wells. The average thickness of the

soil is small, and the underlying limestone has no filtering power. The water, when it reaches the rock, must either flow over its surface, lie in the hollows, or form streams running in the wide cracks. In most places the wells must necessarily be very shallow, mere pits for surface water, or they must be excavated in the rock. In either case it is evident that more or less surface water must find its way in. The filtration being very imperfect, the well is seriously contaminated if there is any source of contamination near. Some deep-well owners have built cemented stone walls from the rock to the surface, so as to exclude, if possible, the surface water. But, that even this fails to prevent pollution is proved by the following chlorine estimations made at my request by Mr. F. J. Pope, M.A. The well is very carefully made, partly in the rock, partly in the overlying clay and soil. The walls from the rock upward are good masonry laid in cement. The samples were taken about every second day. The weather was broken, being characterized by heavy rains with intervals of fine weather. The experiments were made during October, 1890:

Parts of chlorine per million.	Weather.
52	Rain
53	Rain
53.5	Rain
53.5	Fine
54	Heavy rain
54	Fine
54.3	Heavy rain
54.2	Fine
53.5	Fine
53	Rain beginning
54	Heavy rain
54½	Heavy rain
54½	Raining
55	Heavy rain

It is to be noted that the weather before these determinations were made was, on the whole, fine, so that they form a record of the effect of rain on the well. An inspection of the numbers and the weather notes shows clearly that the

amount of chlorine is increased by the rain, but only slowly. There is a cesspool about 30 feet from the well, and it is very likely that the overflow from this, increased by the rainfall, finds its way along the surface of the rock and through the cracks into the well. In the most favourably situated wells on the outskirts of the city I have found from 10 to 20 parts of chlorine to the million. This well was then probably pretty badly polluted even before the rainy season began. I doubt if the most careful cementing above the rock insures a clean well. The limestone itself offers many channels for the passage of the polluted water into the well.

For the sake of comparison I insert here Mr. Pope's report on an underground rivulet in Portsmouth, about two miles from Kingston. The samples were taken during the same period as those from the well:—

"The water issues from a fault which it follows for a considerable distance before emerging.[1] The spring is situated on a hill and is distant from outhouses, refuse pools, &c."

Sample.	Parts of chlorine per million.	Weather.
1	14.6	Fine. Two days after heavy rain
2	14.6	Showery
3	14.6	Showery
4	14.6	Fine
5	15.7	Heavy rain night before sample was taken
6	15.0	Fine
7	14.9	Heavy rain night before
8	14.4	Fine
9	14.0	Fine
10	14.0	Fine
11	I4.1	Fine
12	14.6	Fine
13	14.7	Raining
14	13.7	Heavy rain
15	13.9	Fine
16	14.3	Fine
17	13.9	Showery. Heavy rain night before

[1] A small surface rill disappears into a large crack in the rock about ¼ mile above this.—W. L. G.

Mr. Pope concludes that the chlorine is affected very slightly by rains, but is somewhat decreased by heavy rains owing to dilution with pure water. I think we may take this spring as representing the unpolluted water of this district, as found in deep wells.

In the spring and summer of 1891 I determined the chlorine in 45 wells, selected by Dr. Fee, our Health officer, as suspicious or obviously bad. A few of these wells were not in use for drinking, but for various reasons had not been closed. The majority of them have since been condemned and filled up. Some of them were filthy beyond description, and were yet considered by those who used them to be excellent wells. In depth they varied from 10 ft. to 50 feet. They were scattered all over the city. I have here arranged them in order of purity (as determined by the chlorine test):—

No.	Chlorine.	No.	Chlorine.
1	15	24	127
2	17.8	25	128
3	20	26	131
4	21	27	138
5	26	28	142
6	43	29	150
7	44	30	161
8	45	31	167
9	49	32	168
*10	50	33	174
11	55	34	180
*12	59.6	*35	194
13	64	36	204
14	73	37	210
15	74	38	210
16	77	39	216
17	77	40	216
18	83	41	223
19	84	42	230
20	94	43	230
21	94	44	328
22	97	45	1760
23	106		

Number 45, I thought, must be a salt spring, until I heard that it was from a shallow well dug in the soil of an old cow byre. The chlorine in the majority of these waters is so high that further and confirmatory analysis was needed in order to fix upon the danger line. The chlorides might be derived from mineral instead of from animal sources. Nos. 10, 12 and 35 were submitted to further analysis. The results, which I give here, show that a water containing 50 parts of chlorine to the million is very bad.

PARTS PER MILLION.

No.	Free Ammonia.	Alb. Ammonia.	Chlorine.	Oxygen consumed.	Solids.
10........	.26	.16	194	2.50	2040
12........	1.60	.60	50	10.25	500
35........	2.66	.14	59.6	2.02	735

Nitrates were abundant in each, particularly in No. 10. Number 12 was swarming with bacteria.

The method for determining the oxygen consumed was the alkaline permanganate method of Schulze and Trommsdorf as modified by J. Klein.[1] I have found this method perfectly accurate, as judged by concordance in results, and very rapid and convenient. The whole operation occupies only about twenty minutes.

Some years ago I made a careful analysis of a Kingston well-water containing 15 parts of chlorine to the million and found it pure. The conclusion to be drawn from the foregoing results is that Kingston well-waters containing more than 15 parts of chlorine to the million are suspicious, and are almost certainly bad if the amount reaches 50 parts.

THE WATER WORKS SUPPLY.

Up to the present the supply has been drawn from two points near the waterworks wharf (see map A.) As large drains discharge at points not far above and below this, it was thought (not unnaturally) that the source might be undesirably impure. Analyses of the harbour water have been made several times by the late Dr. Bayne, of the Royal

[1] Journal of the Chemical Society, 1887, p. 1000; Arch. Pharm. [3], 25, 522.

Military College, by Capt. Cochrane (R.M.C.), and by myself. There has been substantial agreement in all these analyses, as follows:

Free ammonia....................	Little or none
Albuminoid ammonia.............	.09
Chlorine	5

The Dominion analyst analysed a sample drawn from a tap in the city, and reported:

Free ammonia....................................	.050
Albuminoid	.100
Chlorine	2.5

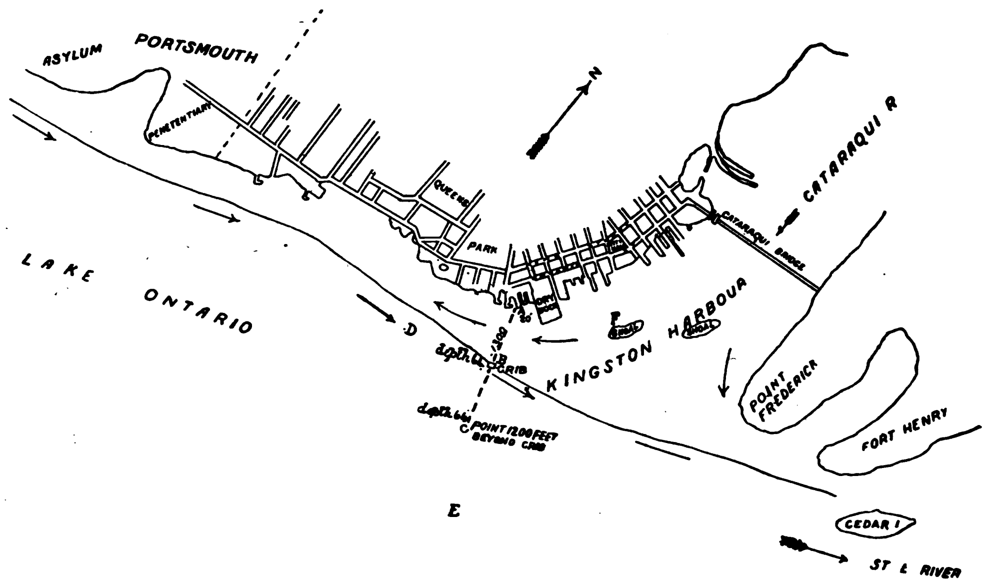
These results indicate a water of fair purity only, and considering the increased flow of sewage owing to growth of the city and extension of the drainage system, it was decided to extend the suction pipe to a point B (see map) 1300 feet out from the present intake. The Board of Health considered it advisable to have the two sources tested to see what improvement in purity would be made by the change. Samples were taken April 15th, 1891, from A at 18 feet from the surface and B at 30 feet from the surface. In this, as on all other occasions during this investigation, the samples were brought to me in numbered bottles, and I was ignorant of the sources from which they were drawn. This freedom from prepossession is perhaps desirable where the results of the analysis depend so much on delicate distinctions of shades, as in Nesslerising. The results showed the present source to be a little better than the proposed:

Sample.	Free Ammonia.	Alb. Ammonia.	Chlorine.	Oxygen consumed.	Solids.
No. 1 (new intake)	.013	.10	5.2	1.38	126
No. 2 (old intake)	.000	.09	5.0	0.82	128

This unexpected result led to a repetition of the analysis. Samples were taken on April 20th:

Sample.	Free Ammonia.	Alb. Ammonia.	Chlorine.	Oxygen consumed.	Solids.
No. 8 (new)	.007	.10	4.5	1.26	106
No. 9 (old)	.007	.09	5.2	1.44	103

This left no doubt that the proposed intake was at any rate no better than the present.



PLAN OF KINGSTON HARBOUR.
Scale 4000 feet to an inch.

Analyses were then made with the object of finding the point nearest the waterworks, at which a better supply could be obtained. Samples were taken on April 30th, 1891, from the following points:

No. 1—1300 feet from shore opposite Murney Tower, in line of Barrie street (map, D).
No. 2—At the proposed intake (B).
No. 3—1200 feet beyond the proposed intake (C).
No. 4—2500 feet beyond the proposed intake (E).
No. 5—Near Carruthers' shoal (F).

With the exception of No. 5 these samples were taken 30 ft. from the surface. No. 5 was taken 22 feet from the surface. The results of the analyses were as follows:

No.	Free Ammonia.	Albuminoid Ammonia.	Chlorine.	Oxygen consumed.	Solids.	Remarks.
1..	none	.085	4.4	1.72	113	Some sediment.
2..	none	.086	3.9	1.64	118	" "
3..	none	.062	4.4	0.88	126	Clearer than 1 & 2.
4..	none	.060	4.5	1.12	102	" "
5..	none	.060	4.0	1.56	140	Slightly unpleasant odour when warm.

Above D, the point at which No. 1 was taken, the principal discharge of sewage is from the Asylum for the Insane, and from the Penitentiary. The analysis shows that the point D is not superior to the proposed intake (B). It also shows that purer water can be obtained by running the suction pipe 1,200 feet farther out than was at first proposed. I was much surprised to find that No. 5, with *albuminoid ammonia* so low, had been taken from a point so far up in the harbour. In my report it was mentioned as inferior to Nos. 3 and 4, as shown by the *oxygen consumed*, the *solids*, and the unpleasant odour (somewhat *marshy*, I noted it at the time) when distilling. The exceptional character may be accounted for on the ground that the harbour water is there (at F) mixed with the water of the Cataraqui River, a sluggish stream flanked by extensive marshes just before it reaches the city. However, the point awaits further investigation.

It now became quite clear that a supply of pure water could be obtained by running out the suction pipe 2500 feet from the shore.

Currents.

In order to complete their information the Waterworks Committee ordered experiments with floats so as to determine the direction of the currents in and near the harbour. These experiments were made by the City Engineer, Mr. T. O. Bolger, the manager of the waterworks, Mr. W. Hewitt, and myself. Professor Carr Harris, of the Royal Military College, made many valuable suggestions. The floats were made by weighting small 12 ft. scantling with bricks tied on at one end. In some cases floats of 24 ft. length were used in the deeper water. Without going into detail, I shall here give the conclusions arrived at after several weeks of careful observation.

1. From the Asylum to near the point D, there is a steady current *down* the lake outside of a line averaging 700 or 800 feet from the shore.
2. Inside this line there is a variable eddy current *up* the lake.
3. The dividing line between the currents moves towards the shore with westerly, and away from it, with easterly winds.
4. From a point near D the dividing line runs in a general direction towards Cedar Island. It must often pass very near the crib (B), but its position is very much influenced by the direction and velocity of the wind.
5. Between the dividing line and the shore, the water of the harbour is comparatively still. The feeble currents are largely controlled by the wind. In quite calm weather there is, however, near the waterworks, a slow current up the lake. On the whole, the harbour water may be considered to be, in comparison with the lake water, still-water.

These results explained the unexpected character of the water over the crib (B). This point is on the dividing line

between the dead water of the harbour and the water moving down the lake. The water at this point is not so clear as that nearer shore, and has nothing to recommend it above the present city supply.

The problem of an abundant supply of pure water is thus easy to solve. Fortunately, Kingston is so situated that the pumping station, near the centre of the water front, is only some 2,500 or 3,000 feet from the inexhaustible supply afforded by the unpolluted waters of Lake Ontario. The only doubtful point is the effect of the great numbers of dead fish which are seen floating in the lake and river at a certain season of the year. This point could be easily settled by analysis.

Temperature.

On July 15th, 1891, some observations of temperatures were made by Mr. Hewitt and myself. A half-gallon corked bottle was lowered to the required depth and allowed to remain for a few minutes. The cork was pulled out by means of a cord attached to it, and about five minutes after bubbles had ceased to come up the bottle was quickly drawn to the surface and the temperature of the water taken. The thermometer used was one made by Negretti & Zambra, graduated in tenths of a degree. The temperatures were taken at the points C, B and A, and an intermediate point.

No.	Distance from Shore.	Depth.	Temperature.
1	2500 ft. (C).	30 ft.	60° F.
2	"	15 "	62.6
3	"	6 in.	64.6
4	1300 ft. (B).	30 ft.	60.8
5	"	15 "	62.2
6	"	6 in,	65.1
7	650 ft.	30 ft.	60.4
8	"	15 "	62.0
9	"	6 in.	65,1
10	20 ft. (A).	18 ft.	62.0
11	"	6 in.	67.1

These readings were taken about mid-day. The day was fine, with a light breeze blowing.

These eleven samples were then compared as to their clearness, &c. No. 1 was found to be the most free from suspended matter. Nos. 6, 9 and 11, were rather dirty. No. 4 also had considerable suspended matter. These results confirmed the evidence given by chemical analysis and by the experiments with floats.

It may be of interest here to mention that my colleague, Prof. Marshall, has found that the temperature of the lake water is just now (Feb. 27) uniformly 32° F. from the ice to the bottom at a depth of 53 feet. This cooling of the deeper waters below the point of maximum density can hardly have been brought about by conduction alone. No doubt there has been considerable mixing of the top layers with the lower by means of the current.

Some Laurentian Rocks of the Thousand Islands.

By Dr. A. P. Coleman, School of Practical Science, Toronto.

The Admiralty group of the Thousand Islands includes one hundred and fifty rocks, islets and islands extending two or three miles southwest of Gananoque. Two quarries and the bare glaciated flanks of the islands and the neighboring shore give excellent exposures of lower Laurentian rocks, here consisting of granite, gneiss and quartzite. Some dykes of fine grained diabase which intersect these rocks, though later than Laurentian are probably of pre-cambrian age, since they do not pierce the Potsdam sandstone which overlies the eastern end of the group.

Granite covers the largest surface and has invaded the gneiss and quartzite, sweeping off portions of them, generally only a few inches or feet in diameter, but sometimes twenty feet or much more across. They are for the greater part quite sharp angled and uncorroded by the granite, and the quartzite fragments often stand out from the surface an inch or so, giving a measure of the depth to which the granite has weathered since the whole region was planed smooth in the Ice Age.

At a distance from these well defined fragments one finds here and there in the granite darker, finer grained spots with no distinct boundary, probably bits of gneiss more strongly acted upon. Here the gneissoid structure can scarcely be recognized, and it may be that some examples showing much of a bluish green augite under the microscope were torn from some deep seated augitic rock not found at the surface.

The granite is in general monotonously red and coarse grained, though finer grained portions occur, and the color sometimes bleaches to a bluish or purplish grey. It has been quarried for various purposes, and specimens prepared in Mr. Forsyth's stone cutting establishment in Montreal display a rich color and fine polish.

Rare veins in the granite or gneiss contain black tourmaline regularly intergrown with quartz, or crystals of greyish perthite with cleavage surfaces a foot across, graphic granite (an intergrowth of quartz and perthite), and massive quartz.

Under the microscope the usual constituents of granites in Ontario present themselves, quartz, potash felspars and and biotite frequently accompanied by hornblende. The rock is then a biotite hornblende granite.

The quartz is of the usual kind, crowded with fluid cavities, often "negative crystals" in form, containing carbonic acid or water with a cube of salt. Innumerable minute needles which are highly refractive and in isotropic quartz sections show parallel extinction, are probably rutile.

The felspars include a little orthoclase, microcline in much larger amounts generally with microperthitic inclusions, and a small quantity of ordinary plagioclase with a low angle of extinction from the twin plane. Micropegmatite in which quartz forms wormlike inclusions in felspar is very common.

The biotite is brown, though more or less weathered into greenish choloritic products, and the green hornblende is still more often decayed. With these minerals are generally found brown titanite in large amounts, as well as the

pale variety, leucoxene, surrounding opaque masses of iron oxide. Thick crystals of apatite often join the preceding minerals. Minute zircons may be seen especially in quartz and the felspars. Magnetite, titanite and apatite with zircon are the only minerals usually idiomorphic. The large amount of titanium is worthy of mention, for titanite often equals the biotite in quantity.

That the granite has undergone strains since solidifying is proved by the frequent occurrence of undulatory extinction in quartz and felspar, as well as cataclase structure on the edge of the larger constituents.

The gneiss shows in most parts the usual wavy, sweeping curves of foliation including lenses of felspar and larger enclosures of quartzite, and is much more varied in character than the granite. It commonly contains a larger proportion of biotite than the granite, and hence is darker in color, though one variety from the mainland is nearly white and formed of thin layers of quartz and felspar almost free from mica. In grain the rock varies from coarse pegmatitic bands with felspars three inches across to very fine grained portions, almost hälleflintas.

A curious structure, probably resulting from a shearing motion, may be seen crossing both granite and gneiss, vein-like bands an inch or two wide, in which the basic minerals have almost disappeared, and quartz and felspar have been rolled into fine parallel plates, from which curves sweep off into the unaltered rock around, the curve on one side reversing the direction of that on the other.

Under the microscope the gneisses prove to contain all the minerals found in the neighboring granite except microcline, which is almost entirely replaced by orthoclase, generally with microperthitic inclusions. In most cases biotite is plentiful, hornblende absent, quartz sparingly present. This is, however, not the case in varieties resembling hälleflinta where quartz is the mineral found in largest amounts. Apatite occurs as needles and not as thick prisms, the form usual in the granite.

A microscopic examination of sections from lines of shear gives proof of immense crushing both of quartz and feldspar, though fragments of microperthite have sometimes resisted the crushing force and are enfolded by the thin layers. Large individuals of quartz are frequently drawn out lengthwise, broken into many pieces with slightly different orientation. It should be mentioned that the gneiss as a whole presents less evidence of violent strains than the granite.

The quartzite, which is generally subordinate to the gneiss, is white or tinged with red by the weathering of some ore of iron, probably pyrite. A little pale greenish muscovite, decayed felspar, specks of tourmaline and titanite complete the minerals visible without the microscope. In thin sections one is struck by the great numbers of rutile needles flashing brilliantly between crossed nicols. Thicker rods, perhaps of the same nature, are strongly dichroic, brown parallel to the chief section of the nicol, almost colorless at right angles to it. Hexagonal brown plates are perhaps biotite, but seem not dichroic. A few crystals of zircon finish the solid inclusions. Cavities, often crystalline in outline, contain the same fluids as were found in quartz from the granite and gneiss; though these cavities, as well as the rutile prisms are much larger than in the other rocks. The only crystal of apatite observed was thick like that from the granite. Cataclase structure is less strongly marked than in either of the other rocks.

In reviewing the three rocks described one is struck by the points of relationship between them rather than by their differences. They must have been formed under certain common conditions; for salt water, carbonic acid under great pressure and oxide of titanium are found in the quartz of all three. Every constituent mineral of the two schistose rocks, except a few scales of muscovite in the quartzite, is found in the granite, which may be looked on in a sense as forming a mean between them. If the various kinds of gneiss and quartzite were blended together, a rock very like the granite would result. It was intended to make a series of analyses to test this chemically, but time to carry out this purpose has failed.

It is impossible to conceive that the widely varying gneisses and their interposed layers of quartzite could have resulted from the consolidation of any viscous or semi-solid magma, though it is quite possible to imagine these schistose rocks as having been contorted when softened by heat in the presence of salt water and carbonic acid, and even melted in part into a viscid granitic magma.

The shearing displacements described above must have taken place after the granite had at least partially solidified. These movements must have occurred long before the dykes of diabase broke through, for they have sharp unaltered walls of gneiss and granite, which at that time were so far cooled as to be brittle.

Recent Auroral Displays.

By Prof. C. H. McLeod, of McGill College.

The auroral display of the night of February 13th was observed throughout the northern portion of North America, in Britain, and probably throughout northern Europe. It was without doubt the most brilliant of the auroras observed here since 1870. In Montreal, it became visible shortly after sunset, and increasing in splendor attained its greatest brilliancy at between 7 and 7.30 p.m. Thereafter, gradually fading, it appeared as a uniform haze at 8.30, and the sky became completely overcast shortly after 9 o'clock. The most marked feature of this aurora was the bright red cone of light having its base between N. and N. 60° W., and extending to the zenith. The cone maintained an approximately constant position, and was of a uniform bright red colour, changing in tint only as it increased to a maximum and faded away. In front of this bright red screen there were slowly moving streamers of brilliant reds and greenish tints, and these also extended at times throughout the whole northern quarter of the sky. Low down in the north there was an arch of white light, and at one or two points in the N. E. there were columnar patches of coloured aurora which also maintained a fairly

constant position. The movements were of the slow and stately order rather than those of the "merry dancers."

Since this aurora there have been several minor ones, and on March 6th there was a display, which, though only faintly coloured, was quite as beautiful as that of the 13th. It was marked by a beautifully folded curtain-like aurora standing above a very dark cloud. The changes in the curtain were very rapid, and at times showed light tints of pink and green. The streamers were numerous, but were not coloured, so far as observed.

It is perhaps worthy of remark in connection with these two auroras that the days on which they occur are included in a list of six days on which bright auroras are supposed to return periodically. The days are Feb. 3, Feb. 4, Feb. 13, March 6, Sept. 9, and Sept. 29. The aurora of March 12th, though not equal to those described, is also worthy of record. Like that of Feb. 13th it faded into a uniformly hazy sky.

The aurora of Feb. 13th marked one of the most violent magnetic storms on record. At the Kew observatory the "magnetometers were not able to record the complete "extent of the vibrations to which free needles were sub-"jected, nor could the entire change of force be secured in "the field of the instrument. The limits, however, clearly "recorded, were 2° of declination, from .1760 to .1830 of "horizontal force, and from .4350 to .4420 units of vertical "force expressed in C. G. S. measure in absolute force."† At Toronto, "during the early morning hours the declina-"tion magnet was considerably west of its mean position, "and east of it during the afternoon. The vibrations were "exceedingly rapid, notably so in the morning when the "range of declination was over 2° 37′. . . . . The "horizontal component was very much affected. Some "of the vibrations were so rapid that they were barely "recorded. The disturbance started with a sharp increase "of the force. In the morning the force was considerably

† Letter to *Nature* by Mr. G. M. Whipple, Feb. 18th, 1892.

"below its mean value, and during the afternoon a rapid "recovery commenced between 0h. 38′ p.m. and 4 p.m. "(Eastern time), an increase of .0096 C. G. S. took place; "the total change of horizontal force during the disturb-"ance was over .0148 C. G. S. Between 6 and 9 p.m. the "vibrations were very swift. The changes in the vertical "component were also considerable."*

This magnetic storm was preceded by a most unusual outbreak of sun spots. The group of spots which became visible by rotation on Feb. 5th was, on the morning of the 8th, and for some days thereafter, easily visible to the naked eye. The area of the group, as measured here on the 8th, amounted in area to about $\frac{1}{120}$th of the sun's visible hemisphere, the length of the disturbed area being about 140,000 and the breadth about 100,000 miles. On Feb. 13th there was also another very large group of spots, then about making good its position on the eastern limit, which added very materially to the total spotted area on this day. This latter is probably the same group of spots which, after making one rotation, is now (March 14th) nearly central on the sun.

The Nickel Deposits of Scandinavia.

By Prof. J. H. L. Vogt, of the University of Christiania.

Prof. J. H. L. Vogt, of the University of Christinia, who is engaged in preparing a work on the nickel deposits of Scandinavia, has in a letter to Dr. A. R. C. Selwyn, Director of the Geological Survey of Canada, dated January 4, 1892, given some interesting facts concerning these deposits.

As these Scandinavian deposits are of especial interest to Canadians, since they resemble in many ways the great deposits occurring in the vicinity of Sudbury,† Dr. Selwyn has placed the letter in the hands of the Editing Committee of the Record of Science, and from it the following facts have been gathered. F.D.A.

* From a statement kindly furnished by Mr. C. Carpmael.

† See paper "On the Nickel and Copper Deposits of Sudbury, Ont," by Alfred E. Barlow, Can. Rec. of Sci. Vol. 5, Number 1, p. 68.

All the Scandinavian Nickel Deposits—perhaps 50 to 80 have been worked to a greater or less extent—are intimately related to masses of gabbro, a rock composed of plagioclase feldspar and augite, or of norite, a closely allied rock composed of plagioclase feldspar and hypersthene. The ore is Magnetic Pyrites, containing 3 to 5 per cent. of nickel and cobalt, which ore is a constituent of the gabbro but is principally concentrated along the contact of the gabbro with the surrounding gneissic rocks. The accompanying cuts illustrate the mode of its occurrence in three localities.

The scale is in meters.

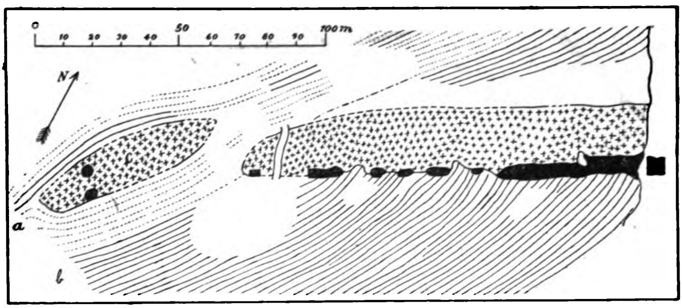


FIG. 1.—THE NYSTEN AND BAMLE MINES.

a.—Red Gneiss.
b.—Black Gneiss and Mica Schist.
c.—Gabbro.
The black portions are openings on pyrrhotite holding 4 p. c. of Nickel.

Associated with the Magnetic Pyrites ($Fe_8 S_9$) are ordinary Iron Pyrite ($Fe S_2$) Copper Pyrite ($Cu Fe S_2$) and in some places Titanic Iron Ore.

The Magnetic Pyrites when pure usually contains as before mentioned 3 to 5 per cent. of nickel and cobalt, but as much as 7 per cent. is sometimes present. These metals are usually present in the proportion of one part of cobalt to from seven to twelve parts of nickel. The Iron Pyrites on the other hand usually contains more cobalt than nickel. Copper Pyrite is never present in large amount.

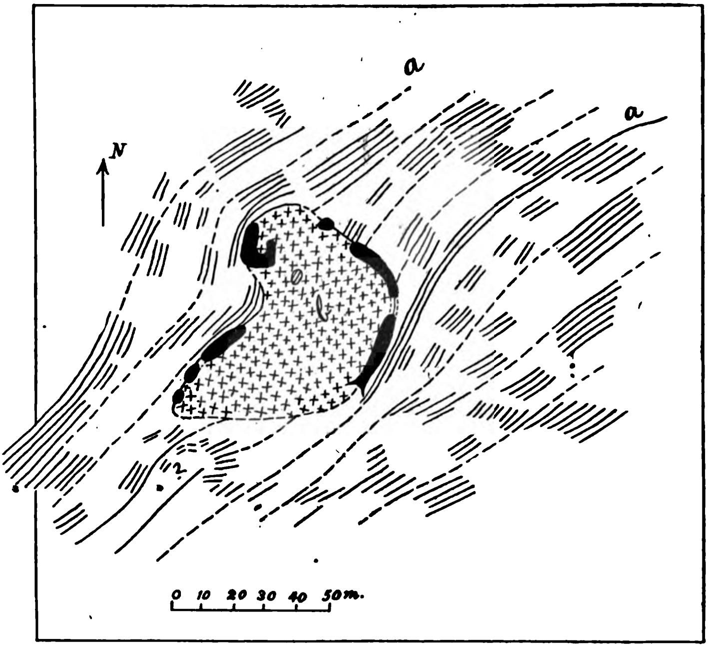


Fig. 2.—The Meinkjaer Mines.

a.—Gneiss and Hornblende Schist.
b.—Norite.
The black portions are openings on pyrrhotite with 4 p. c. of Nickel.

Nickel, cobalt and copper are present on an average in the ore in the proportion of about 100 parts of nickel to 25 to 60 of copper and 8 to 10 of cobalt. These proportions hold good not only in the case of the numerous Scandinavian deposits, but also in those of other parts of Europe, as in Italy and Germany. This fact is of "high geological and genetic interest," as there seems to be some general law determining these proportions and it will be very interesting to ascertain whether they hold good in the case of the Sudbury deposits.

In the nickel ore in a few places the mineral Pentlandite (Eisennickelkies) has been discovered and in a single case

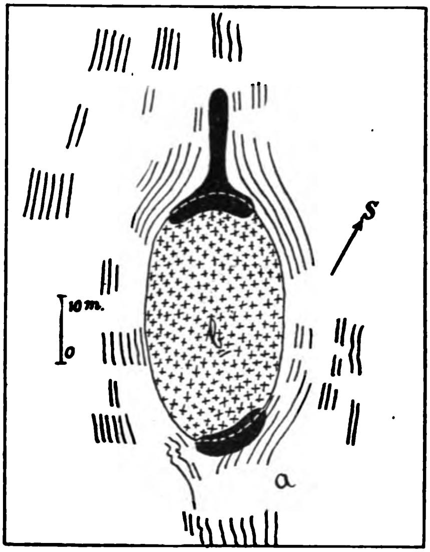


FIG. 3.—THE SKAUG MINE.

a.—Gneiss, etc.
b.—Gabbro.
The black portion shows the position of the Nickel deposits.

the mineral Cobaltite. The following figures give the number of tons of nickel annually produced in Norway in the several periods mentioned :—

1865–71	1872–73	1874–75	1876–80	1880–87	1888–91
50 to 80	150 to 200	250 to 320	80 to 120	60 to 120	90 to 130

The mattes hold about 50 p. c. of nickel. At present there are three or four smelting works in operation in Norway.

In Sweden in 1870-75 about 80 to 150 tons of nickel were produced annually, in 1880-85 about 40 to 80, while of recent years the annual output has fallen to from 10 to 30 tons.

Note on Magnesite from near Black Lake, Que.

By J. T. Donald, M.A.

(Read before the Natural History Society, Jan. 25th, 1892.)

In the "Annotated list of the minerals occurring in Canada," read before the Royal Society of Canada in May, 1889, Mr. G. Christian Hoffmann states that Magnesite "has so far only been met with in rock masses forming in association with serpentine, dolomite and steatite, beds in the townships of Sutton and Bolton, Brome County, Province of Quebec."

The object of this note is to place on record the occurrence of this mineral in characteristic crystals as incrustations on masses of serpentine on one or more of the lots known as numbers 24, 25, 26, Range A, Coleraine, Megantic County, Que. Since finding it in this locality, in the autumn of the year 1890, the writer has been on the look out for it at numerous other points in the Asbestos area, but as yet has not found it except in the locality above mentioned. Calcite, however, is quite common as an incrustation on the Serpentine throughout the area in which the asbestos is mined.

The Waters of two Artesian Wells in the Eastern Part of the City of Montreal.

By J. T. Donald, M.A.

(Read before the Natural History Society, Jan. 25th, 1892.)

One of the wells in question is on the property of Messrs. R. White & Co. on the corner of Craig and Beaudry Streets, the other is on the property of Messrs. M. Laing & Sons on the corner of St. Catherine and Parthenais Streets. Strictly speaking the latter is not entitled to be called an artesian well, as it yields water only by pumping. Mr. P. Laing informs me the water is "delivered by a pump having 36 inch stroke, and this without forcing throws twenty-five gallons per minute, and this pump has been at work for weeks without the slightest falling off in supply."

Messrs. R. White & Co. find that their well flows at the rate of thirty gallons per minute. It is however the inten-

tion of this firm to put in a pump, as a much greater quantity will be required to supply their own and their tenants' requirements.

The White well has a total depth of 266 feet, 60 feet through clay and gravel and 206 feet through rock. Water was obtained at a depth of 258 feet, but drilling was pushed to a further depth of 8 feet.

The Laing well has a total depth of 325 feet; 56 feet through clay and earthy material and 269 feet through rock. Unfortunately none of the rock matter removed in boring these wells has been preserved, except a single fragment from the White well to which reference will be made again.

A partial analysis of the water from each of these wells has been made and the results in grains per imperial gallon are as follows:

	Laing.	White.
Total Solids........................	43.70	36.42
Suspended Matter..................	2.04	.....
Calcium Carbonate..................	*14.32	heavy trace.
Calcium Sulphate	12.65	.....
Sodium Chloride....................	9.38	2.32
Sodium Sulphate....................	.....	6.85
Alkaline Carbonates & Bicarbonates . with a little Silica................	5.31	27.25

When the sample of Laing water was sent for analysis, the Messrs. Laing wrote saying that although it was turbid it was as clear as any they could obtain, nothwithstanding that they had been pumping for weeks. A few days after the analysis of the sample had been made the turbidity disappeared, and Mr. Laing informs me that "the pump is now delivering water that shows no cloudy matter whatever," and has sent me a sample which confirms his statement.

It is worthy of note that these two waters, which represent wells a short distance a part should show such a difference in their contained solids. The salts in the Laing water are such as one with a knowledge

* With a little Magnesium Carbonate.

of the locality of the well would expect to find. In the case of the White water it is rather surprising to find an almost entire absence of lime and magnesia, and the presence of a large quantity of alkaline salts, especially the carbonates and bicarbonates. In endeavoring to learn something of the source of these alkaline salts the writer communicated with the party who bored the well for Messrs. R. White & Co. He was of opinion that the only rock encountered in boring was limestone. Mr. R. White interrogated his employees who had assisted in the work of boring, and learned that one of them had preserved a small fragment of tho rock that was taken from the depth at which water was reached. On examination this proved to be not limestone, but apparently a shaly substance intersected, however, by minute veins of calcite. This shaly rock may be the source of the alkaline salts. The fragment of rock has been handed over to Mr. Frank D. Adams of McGill College, who proposes to submit it to microscopical examination, and who will be very glad to receive any samples from or information concerning any other borings made in this vicinity, as he is collecting materials for a detailed geological map of the whole district about Montreal.

Proceedings of the Natural History Society.

The third monthly meeting was held on the evening of January 25th, the Hon. Edward Murphy, President, in the chair.

The minutes of November 30th 1891, were read and approved.

Minutes of Council Meeting of January 17th, were approved.

A letter was read from the Museum d'Histoire Naturelle de Bordeaux asking for the publications of the Society. It was on motion by Mr. Beaudry resolved to place this Society on our exchange list.

Mr. J. T. Donald read a paper on crystallized magnesite from Black Lake, Que., and some notes on native platinum from British Columbia.

He also read a paper on the composition of the waters of two artesian wells in the eastern part of the city of Montreal.

After the paper had been discussed, it was moved by Mr. Adams, seconded by Mr. Beaudry that the thanks of the Society be tendered to Prof. Donald for his interesting communications, and that he be requested to publish them in the *Record of Science.*—Carried.

The meeting then adjourned.

The fourth monthly meeting was held on February 29th, Rev. Dean Carmichael, President, in the chair.

The minutes of meeting of January 25th, were read and approved.

Minutes of Council meeting of February 22nd were read.

Donations to Library, Dr. T. Sterry Hunt's last work. "Systematic Mineralogy," and to Museum, a swallow's nest from W. A. Oswald, Belle Riviere. On motion by J. S. Shearer, seconded by J. S. Brown the thanks of the Society were tendered to the donors.

Mr. W. H. Lynch, proposed by J. S. Shearer, seconded by the Very Rev. Dean Carmichael, and Mr. J. G. Shaw proposed by James Gardner, seconded by John S. Shearer were elected ordinary members, the rules requiring a delay of a month having on motion been suspended.

It was moved by J. Stevenson Brown, seconded by C. T. Chambers, that the Society deeply regrets the death of Dr. T. Sterry Hunt and desires to place on record its great indebtedness to him for his labors in its behalf while President of the Society and also during his many years of active membership, also for his valuable contributions to Canadian science.

Mr. W. H. Lynch then gave his interesting lecture on the "mineral resources of British Columbia." On motion of J. Stevenson Brown seconded by W. L. Lockerby the thanks of the Society be accorded to Mr. Lynch for his valuable lecture.

PROCEEDINGS OF THE MONTREAL MICROSCOPICAL SOCIETY.

The regular monthly meeting of this Society was held on January 11th when it was expected that Prof. Cox would give a paper on polarized light, but owing to his indisposition the lecture had to be postponed. The members, however, were requested to bring slides or other objects of interest, which several of them did, and a very successful meeting resulted.

Feb. 8th, Jos. Bemrose, F.C.S., read a paper on "Crystalline forms modified by Impurity." The formation of crystals was carefully explained and the effect of impurities on the forms of crystal described. Poisons forming crystals, it was stated, could be detected, separated from food, examined microscopically, and the kind of poison identified by its crystals. The lecturer had specially prepared a large number of slides to illustrate his subject, which demonstrated that there was great beauty of form and colour, as well as delightful and valuable results to be obtained by careful study of crystals. Polarized light was largely used in demonstrating the structure of the crystals exhibited.

Feb. 26th. A special meeting was held to hear Prof. Cox's paper "Polarized light, its usefulness in indicating structure." Ordinary light waves were first referred to, and then the special character of polarized light was treated of. The effect of Iceland spar in dividing the rays of light was demonstrated by introducing a crystal of that substance into the lantern, when the most wonderful changes in colour were observed on the screen. The actual formation of crystals was also shown in the same way by placing Benzoic Acid between two thin plates of glass, when after heating, the crystals could be observed forming. This was a most successful experiment and clearly demonstrated the value of "polarized light in indicating structure." Throughout, the lecture was illustrated at every point with mechanical and electrical apparatus, and at its close a vote of thanks was proposed by Hon. Senator Murphy, seconded by Dr. J.

B. McConnell, to Prof. Cox for his instructive and interesting paper.

The next meeting will be held March 14th, when the Rev. W. J. Smyth will give a paper on "The House Spider."

Notices of Books and Papers.

Tin Deposits in Queensland.

The reports issued by the Geological Survey of Queensland, under the charge of Mr. Robert L. Jack, must prove of very great value to Australians, particularly to mining men, as, certainly, they are very instructive to their antipodal readers who are interested in geological work or the history and nature of the different mineral horizons. The reports, as read by us, are all written in a peculiar style, but it is extremely simple and succinct, and the many items of fact or detail are given in a manner very direct and concise, as all reports should be, each sentence being shorn of every unnecessary word.

The wonderful richness of the Australian mines, and the great area of mineral lands, are well known; it would seem as if men's wildest dreams had been surpassed in their realization by the vast wealth of precious metals and priceless gems that has poured forth so bountifully from the natural treasuries of this wonderful land. Realizing the importance of as complete knowledge as possible of the different mining fields, of the geology of each district, with the exact conditions and relationships of the ore deposits with reference to the enclosing or neighboring rocks, the reports of this survey would indicate that its chief endeavors had been spent in examining and reporting upon the different mining districts, explaining the geological formations, and giving the results of the mining operations up to date. Such reports, with their accompanying maps, must be a very useful and reliable source of information to all mining men, who, we believe, must look upon the work of Mr. Jack and his associates as being well done and of great practical benefit.

Reading over the reports from the different fields, issued last year, we were much interested by that one on the tin deposits and their mining, in the Coolgarra District. The rocks consist mostly of altered vertical greywackes, quartzites and shales, flanked on the east by lofty granite ranges, there being no sharply defined boundary line between the granite and the sedimentary rocks, except that the latter have become more flinty and felsitic. Throughout the locality, are dykes

of some altered basic rock, with no prevailing direction, that are found more frequently in the sedimentary strata than in the granite, sometimes as intrusive sheets along the bedding planes, elsewhere following joint planes, even at times penetrating quartz veins. These dykes are the source of the tin, which is found only as the binoxide, cassiterite, or "tin-stone," running irregularly through the gangue in fine "stringers" or "leaders," that often swell out into large bunches, or else the ore is finely disseminated throughout the whole mass. As would be expected, more or less "stream tin," from the disintegration of the dykes, has been obtained by washing the alluvial bottoms of the gullies.

In mining, some of the claims have done considerable exploration work, and the ore has generally been found associated with galena, iron pyrites and more or less arsenical pyrites. The ore is concentrated to a form of rich matte, or "black tin," preparatory to shipment to the smelters, by roasting it in large calciners, and from 1884 to 1888, from 4,851.5 tons of ore crushed, the yield of black tin was 352.6 tons.

This Coolgarra tin deposit is interesting and peculiar from the fact that the mineral is found in these dykes of basic rock, while in other parts of the world tin is found for the most part in granite, in "stockworks," or masses traversed by many minute veins which necessitate the working of the whole mass to gain the ore. In Saxony large areas of porphyry have been mined for tin, but we can find no record of tin being found under such conditions as those described above.

It is strange that as yet throughout the world the areas in which tin is found are so few and limited in size, and that on this continent, which has been so prodigal in its production of all other metals, tin in sufficient quantities to be mined profitably is almost unknown. It holds such a strong place in commerce, where it is of such great economic use in tinning iron plates, and for the manufacture of bronze, bell metal, pewter, Britannia metal, etc., that there is a firm and growing demand for it, and any new area reported as productive of this metal immediately receives great attention, though many false alarms have resulted from men mistaking zinc blende, or "Black Jack," for tin stone, or by men manufacturing alluvial tin deposits, or placers, by importing several barrels of ore from Cornwall, and sagaciously scattering it about at some suitable spot, deluding some unsuspecting speculators into buying what they thought was better than a gold mine.

W. A. Carlyle, M.E.

RY, 1892.

87 feet. C. H. McLEOD, *Superintendent.*

KY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
6.7	10	0	00	Inap.	Inap.	Inap.	1
0.0	10	10	00	0.44	....	0.44	2
...	..	..	00	0.15	3.0	0.42	3 .... SUNDAY
7.5	10	1	35	...	0.1	0.01	4
3.3	10	0	75	....	0.2	0.02	5
0.0	10	10	00	....	4.1	0.41	6
5.3	10	1	00	....	0.7	0.07	7
5.8	10	1	47	....	....	....	8
4.8	9	0	84	....	0.7	0.07	9
...	..	.	93	....	....	....	10 .... SUNDAY
5.3	10	0	99	....	....	....	11
9.5	10	7	00	0.03	0.4	0.07	12
0.0	10	10	00	....	1.7	0.17	13
8.8	10	3	00	0.11	5.0	0.61	14
7.0	10	0	03	....	....	....	15
0.0	0	0	78	....	....	....	16
...	..	..	00	....	....	....	17 .... SUNDAY
0.0	10	10	00	....	4.3	0.43	18
7.2	10	0	00	....	5.0	0.50	19
5.8	10	0	38	....	.	....	20
5.3	10	0	00	....	1.6	0.11	21
8.0	10	0	00	....	1.4	0.14	22
6.7	10	0	00	.. .	1.0	0.09	23
...	..		00	....	0.9	0.09	24 .... SUNDAY
0.0	10	10	00	....	4.5	0.43	25
8.0	10	4	00	....	2.1	0.21	26
6.3	10	0	42	....	0.1	0.01	27
0.0	10	10	00	....	0.8	0.08	28
0.0	10	10	00	....	1.8	0.18	29
8.7	10	2	00	....	0.3	0.03	30
...	..	..	36	....	....	....	31 .... SUNDAY
7.4	...	....	19.0	0.73	39.7	4.59	Sums ....
6.5	....	....	¶31.8	0.86	30.3	3.71	18 Years means for and including this month.

-level and

rcury.

100.

2nd; the

20th, giving

Warmest

th. Highest

barometer reading was 30.707 on the 11th; lowest barometer was 29.170 on the 7th, giving a range of 0.537 inches. Maximum relative humidity was 100 on the 20th. Minimum relative humidity was 56 on the 1st and 27th.

Rain fell on 5 days.

Snow fell on 22 days.

Rain or Snow fell on 23 days.

Auroras were observed on 1 night.

Fog on 1 day.

ABSTRACT

Meteorological Observations, McGill C

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	Mean.	§
1	27.18	34.5	18.7	15.8	29.9847	
2	21.13	28.5	16.6	11.9	30.0225	
3	24.85	27.6	21.4	6.2	29.8777	
4	20.17	26.6	15.3	11.3	30.0230	
5	7.57	16.8	3.5	13.3	30.1288	
6	3.02	12.8	−4.7	17.5	30.3510	
SUNDAY..........7	.....	19.0	7.5	11.5	......	AY
8	20.80	24.8	17.6	7.2	29.6062	
9	23.92	31.0	18.7	12.3	29.7837	
10	16.52	24.4	11.8	12.6	29.9578	
11	20.93	27.1	9.7	17.4	29.4215	
12	12.03	25.2	1.7	23.5	29.2698	
13	−4.48	2.5	−9.0	11.5	29.7713	
SUNDAY..........14	.....	14.5	−5.0	19.5	....	AY
15	18.40	32.9	10.5	22.4	29.9727	
16	6.68	11.2	1.8	9.4	30.5313	
17	7.10	12.0	3.4	8.6	30.5832	
18	9.45	18.8	−2.5	21.3	30.3137	
19	16.13	24.4	4.4	20.0	30.3358	
20	26.63	30.0	20.1	9.9	30.3635	
SUNDAY..........21	.....	33.7	28.8	4.9	......	AY
22	33.38	36.2	30.4	5.8	30.5545	
23	33.45	37.5	30.4	7.1	30.5455	
24	31.27	37.9	24.2	13.7	30.3822	
25	30.82	36.8	26.4	10.4	30.1785	
26	24.13	38.8	3.5	35.3	30.3982	
27	−1.62	11.0	−8.6	19.6	30.9010	
SUNDAY..........28	.....	16.5	−5.8	22.3	....	AY
29	18.15	27.2	6.0	21.2	30.2570	
............Means	17.91	24.83	10.23	14.6	30.1406	
18 Years means for and including this month.......	15.72	24.17	7.04	17.1	30.0446	or tis

ANALYSIS OF WIND R

Direction.......	N.	N.E.	E.	S.E.	S.	S.
Miles............	1168	3160	672	226	432	3
Duration in hrs..	88	216	55	24	59	
Mean velocity....	13.3	14.6	12.2	9.4	7.3	2

Greatest mileage in one hour was 52 on the 15th.

Greatest velocity in gusts 60 miles per hour on the 15th.

Resultan

Resultan

Total mil

Published quarterly; Price $3.00 the Volume of eight numbers.

VOLUME V. NUMBER 3.

THE CANADIAN RECORD OF SCIENCE

INCLUDING THE PROCEEDINGS OF
THE NATURAL HISTORY SOCIETY OF MONTREAL,
AND REPLACING

THE CANADIAN NATURALIST.

CONTENTS.

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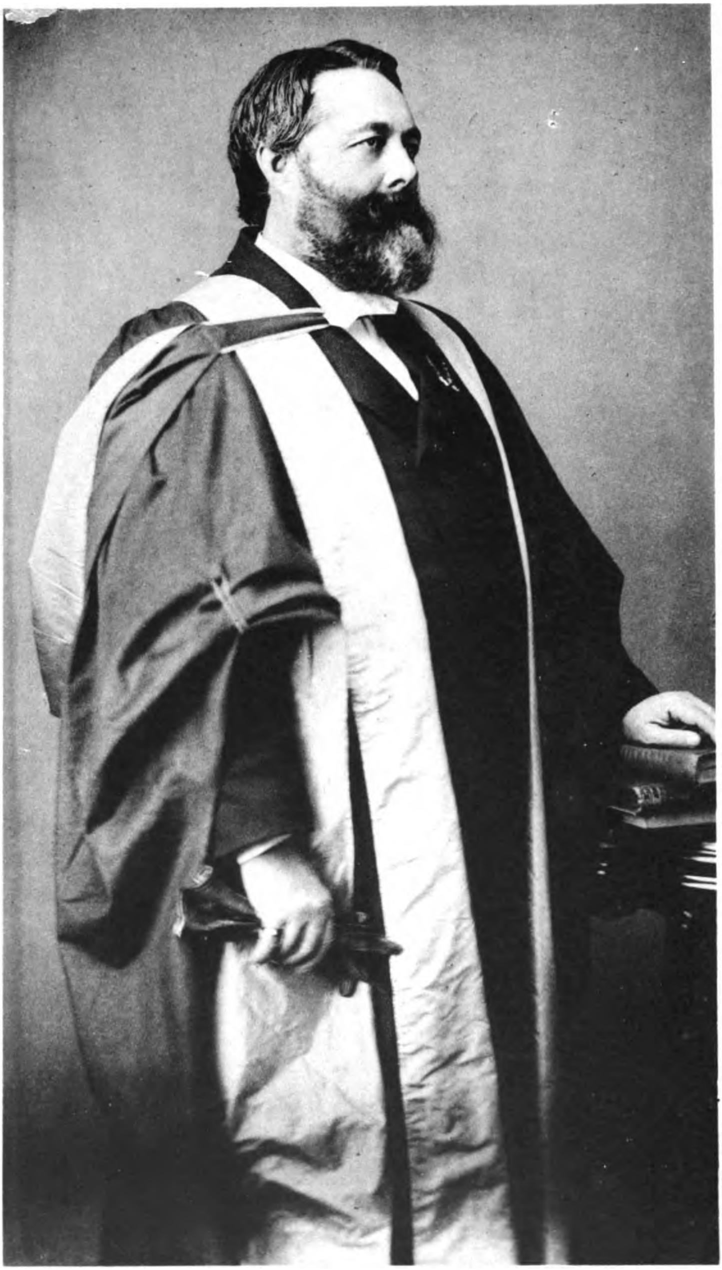

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T. Sterry Hunt

THE

CANADIAN RECORD

OF SCIENCE.

VOL. V. JULY, 1892. NO. 3.

THOMAS STERRY HUNT, LL.D., F.R.S.

Thomas Sterry Hunt was born in Norwich, Conn., on September 5, 1826, of an old New England family. His ancestor, William Hunt, was one of the founders of Concord, Mass., in 1635. His maternal grandfather, Consider Sterry, of Norwich, was a civil engineer and mathematician, and was the author of text books of arithmetic and algebra, published 100 years ago.

Mr. Hunt was destined for the profession of medicine; but after preliminary studies, his love for chemistry and mineralogy led him, early in 1845, to become a special student, and afterward assistant under Prof. Benjamin Silliman, sen., in Yale college. Two years later, after working for a short time in the Geological Survey of Vermont, he was selected, on Silliman's recommendation, by Mr., afterwards Sir William, Logan to be the chemist and mineralogist to the then recently organized Geological Survey of Canada. In this position he remained as the colleague and assistant of Sir William for more than twenty-five years, till his resignation in 1872. His work in this capacity is well known. He was employed in the earliest scientific investigations of the petroleum, the rock salt, the phosphates, and the iron and copper ores of Canada, and also in researches on the composition of a great number of rocks

and minerals, of mineral waters and of soils, while he devoted a large amount of attention to the structure and composition, at that time so little known, of the ancient crystalline rocks of the Ottawa Valley and the Great Lakes; in unravelling the stratigraphical intricacies of which Logan and his assistant Murray were at the same time actively and most successfully occupied. He thus had an important share in the great work of instituting the Laurentian and Huronian Systems of Geology, and in systematising our knowledge of the oldest rocks of Canada and of the world. This work he afterwards followed up independently, in the development of the Norian, Montalban, Taconian and Kewenian systems, in which he included various groups of ancient rocks between the Laurentian and the Cambrian; and though some of these groups may be regarded as still in dispute, there can be no question of the great scientific value of Hunt's studies of them and of the new facts which he contributed to their discussion.

While connected with the Geological Survey, Hunt willingly aided in the drudgery of literary work and administration, for many parts of which his early culture and extensive range of reading and knowledge well fitted him.

At this time also he conceived and published in a succession of papers those wide views on Chemical and general Geology, which were embodied in his greater works, and more especially in his Mineral Physiology and Physiography (1886), in which he discusses with a power and range of knowledge rarely equalled the original condition of our planet, and the genesis of its more ancient rocks, as well as the processes of decomposition, recomposition and metamorphosis to which they have been subjected. This great and eminently suggestive work deserves the careful study of all concerned in Petrography or Physical Geology, who whether or not they may agree with all its conclusions, will find very much to instruct and to stimulate and guide thought and investigation. This work alone, with the earlier Essays on Chemical Geology, would be sufficient to form the basis of a great reputation, and must retain its place as

a leading authority on the subjects of which it treats. As the author himself states, this work and more especially the "Crenitic" hypothesis developed in it, are "the result of nearly thirty years of studies, having for their object to reconstruct the theory of the earth on the basis of a solid nucleus, to reconcile the existence of a solid interior with the flexibility of the crust, to find an adequate explanation of the universally contorted attitude of the older crystalline strata, and at the same time to discover the laws which have governed the formation and the changing chemical composition of the stratiform crystalline rocks through successive geologic ages."

To Dr. Hunt we thus owe some of the earliest attempts to subdivide and classify in a scientific manner the stratiform crystalline rocks; a work to which he brought not only his studies throughout Canada and the United States, but also the results of enquiries conducted during repeated visits to the British Islands and to continental Europe. In pursuing these studies and while reviewing and controverting various hypotheses, including the igneous or plutonic, the metamorphic and the metasomatic, all of which he rejected as irreconcilable with observed facts, and as violating chemical theory, Dr. Hunt vindicated what he deemed the essential soundness of the still imperfect Wernerian aqueous view, and advanced, as its proper development and completion, his own crenitic hypothesis. According to this theory, the source of the various groups of crystalline rocks was "the superficial portion of a globe, once in a state of igneous fusion, but previously solidified from the centre. This portion, rendered porous by cooling, was permeated by circulating waters, which dissolved and brought to the surface during successive ages, after the manner of modern mineral springs, the elements of the various systems of crystalline rocks. These rocks thus mark progressive and necessary changes in the mineralogical evolution of the earth."

Dr. Hunt never abandoned the scientific pursuit of chemistry and mineralogy. In the former science he summed

up the general conclusions of his researches in 1887, in his work entitled "A New Basis of Chemistry," which has gone into a third edition and has been translated into French. His latest work, published in 1891, "Systematic Mineralogy," gives a new classification of the mineral kingdom based on an improvement of what used to be called the Natural History System, followed long ago by Möhs and Jameson. It would be premature to express any opinion as to the acceptance by chemists and mineralogists in general, of the new views propounded in these works; but they are unquestionably able and full of important generalizations and suggestions which must make their mark in the science of the future.

Dr. Hunt found time to do some work as an educator. He was professor of chemistry in Laval University, Quebec, from 1856 to 1862, during which time he delivered annual courses of lectures in French. He continued to be honorary professor until his death. He was also for several years lecturer in McGill University, Montreal, and was professor of geology at the Massachusetts Institute of Technology. 1872-1878. Among his academic titles were those of M.A., Harvard; Sc.D., Laval; LL.D., McGill, and finally LL.D., Cambridge, England. He was elected a fellow of the Royal Society of London in 1859. He was a member of a large number of other societies, both Canadian and foreign. A member of the National Academy of Science of the United States since 1873, he was president of the American Association for the Advancement of Science, and of the American Institute of Mining Engineers, and twice president of the American Chemical society. He was one of the original members and the third president of the Royal Society of Canada, which, uniting some features of the British Association with those of a Royal Society, elects a new president annually. One of the organizers of the International Geological congress, he was its first secretary, and was a vice-president at the congresses of Paris, 1878, Boulogne, 1881, and London, 1888. In connection with the great industrial exhibitions Dr. Hunt represented Canada as a

member of the international juries at Paris in 1855 and 1867 and at the Philadelphia Centennial Exhibition in 1876. He was an officer of the French order of the Legion of Honor and of the Italian order of St. Maurice and St. Lazarus.

In 1878, Dr. Hunt retired from public professional life and devoted himself mainly to the perfecting of his more important works in new editions and to the preparation of his "Systematic Mineralogy." His health and strength, however, gradually declined, and continuing to work almost to the last, he passed away peacefully on Friday, February 12th, 1892. His death at a comparatively early age must be deplored as a great loss to science; but he had the good fortune, not granted to all scientific workers, to have means and leisure in his closing years to bring together in a complete and elaborated form all the principal scientific results of the work of his life.

Dr. Hunt was at the time of his death one of the oldest members of the Natural History Society of Montreal. He had been its President, and for many years one of its vice-presidents, and a member of its council. He took a lively interest in the society and in its publications; and frequently contributed papers and lectures to its proceedings. The Society owes much to his long continued and active influence in its affairs.

In 1878, Dr. Hunt married the eldest daughter of the late Mr. Justice Gale, a lady of culture and literary taste, who survives him.

It is proper to state that the above notice is taken in part from biographical sketches published in the Montreal *Gazette* and elsewhere.

The Experimental Farms of Canada.

By Professor D. P. Penhallow.

The work now being conducted by the Central Experimental Farm at Ottawa and its several branches, had its origin in a resolution of the House of Commons of the 30th January, 1884, appointing a Committee "to inquire into

the best means of encouraging and developing the Agricultural Industries of Canada, and to report thereon to the House."[1] The testimony collected under this authority subsequently led to the appointment of Mr. Wm. Saunders, of London, as Special Commissioner to inquire into and report upon the system of experiment stations in operation in the United States. This duty he discharged in a very full and conscientious manner, the results being embodied in a report to the Minister of Agriculture. Acting upon the information thus obtained, and having in mind the most immediate needs of the country at large, a system of experimental farms was established, having the central farm at Ottawa, and Mr. Saunders as the Director.

In any attempt to pass in review the work of such an establishment as the one now under consideration, it should be clearly borne in mind that there are several points of view from which it may be regarded: first, as an institution which shall promote strictly scientific inquiry, leaving the practical application to others; second, as an institution designed to adapt the results of scientific inquiry to practical ends, to test and verify the work of others, and serve as a bureau of information. And again, viewing each of these objectives with reference to the particular conditions of agricultural progress, and therefore the special needs of the country at large. It would, therefore, be manifestly improper to lay down special limits within which such work must proceed according to the highest standard of value, regardless of surrounding conditions.

Experiment stations may be regarded as having attained to their best development in Germany—practically the land of their origin. There their work is specialized. All of it is based upon the fundamental idea that a fact once established may serve as a permanent basis for the exposition of natural laws. Their work is, therefore, scientific, and the results are of great value as scientific data. With few exceptions, they do not recognize the practical appli-

[1] Report of the Select Committee appointed by the House of Commons to obtain information as to the Agricultural Interests of Canada. 1884.

cation of the results obtained, which is wholly committed to the attention of others more directly interested.

In England, but little attention has been paid to such work on the part of Government, so that such as has been carried on has devolved upon private individuals. A most conspicuous case of this kind is to be found in Rothamsted, where since 1843 a most important series of investigations has been conducted by Sir James Lawes and Dr. J. H. Gilbert. But here again the aim is scientific, not practical, although in the extensive field experiments we find an admirable combination of the two. The results obtained contain an elucidation of some of the most important laws governing the growth and nutrition of plants, ranking high as scientific achievements.

But because in Germany and England the aim is scientific and not practical, it cannot be said that these institutions fail to fulfil the objects for which they were established—promotion of the agricultural interests—and that agriculture suffers in consequence. Far from it. For though the reduction of such results to practice may result in a slower rate of progress, yet is that progress of the most substantial character.

In the United States, where the experiment stations are of recent origin, they have multiplied with great rapidity, until now every State of the Union possesses one or more. Because of their number, rapidity of development and extent of country, as well as the very diverse interests, agricultural, political and personal, to be satisfied, also owing to the want of properly trained officers to conduct the work, these institutions exhibit all grades of efficiency. In some, the scientific basis has been the leading idea from the outset. In others, the immediate reduction to practice of half-gathered facts, and thereby the cultivation of an unstable popularity with the farming community, has dominated all other considerations. In all these stations the scientific work is unduly hampered by the continual performance of mere routine work, such as is involved in the analysis of fertilizers, the identification of plants, testing

of seeds and other work of a similar nature. It is a class of work which, while important in its way, makes no demands upon original powers, and does not call for high scientific capacity. To saddle it upon those who are qualified for work of a high order, is to seriously limit their usefulness and mar such results of scientific value as they may obtain. To divert the appliances of well-equipped stations to such purposes, is to belittle the object of their foundation. It should rather be relegated to separate institutions of a special character, or placed in the hands of a distinct staff. It is probable, however, notwithstanding the short period within which their growth lies, a careful observer will note that, from the first, there has been a decided tendency towards the position first defined and assumed by the more conservative. Men of better capacity are constantly working to the direction of these institutions, as pebbles come to the surface of sand, and with this change there is necessarily less poorly directed effort, with more results which will bear scientific scrutiny, and thus the output is becoming of greater value with each year. Acting as a central bureau, the Department of Agriculture at Washington collects all the valuable material as issued, and publishes it monthly in such a digested form as renders it of direct value to the farmer, with whom rests the final reduction to practice. This may be regarded as the ideal method of bringing the results of scientific inquiry within reach of the farmer of average education and opportunity. It cannot be doubted, however, that the final solution of the difficulties now but too obvious will be satisfactory.

My object in thus bringing out the characteristic features of these institutions in other countries is that we may more clearly understand the particular field which is being cultivated in Canada.

Work on the Central Experimental Farm at Ottawa was commenced in 1887. The first report was issued in 1890, followed by a second—the last up to date—in 1891. The Director, Mr. Wm. Saunders, is assisted by a staff of nine chiefs of departments, including an Agriculturist, Horticul-

turist, Chemist, Entomologist and Botanist, and a Poultry Manager, together with four superintendents of branch farms.

The Branch Experimental Farms established at the date of the last report are four in number, and are located at Nappan, Nova Scotia, for the Maritime Provinces; Brandon, Manitoba; Indian Head, North-West Territories, and at Agassiz, British Columbia. The central farm serves as the centre of supply, the branches being designed more as local testing stations.

As a result of the first year's operations, the Director was able to observe that "Canadian farmers are making careful inquiries for more full and accurate information regarding the numerous and varied operations pertaining to their calling; they desire to have the mysteries which surround some of the operations of Nature explained as far as this is practicable, and it is our object to foster and stimulate such a spirit of inquiry which will, it is believed, result in the speedy advancement of agriculture, and thus in material and lasting benefit to the country."

The intelligent interest manifested by the farmers in the operations of an institution designed and supported in their behalf, as thus indicated, is in itself a most hopeful sign, but it will be well to see what efforts are made to carry out the promises thus held forth by the Director at the very beginning of his first report.

During the year 1889, there were received 6,864 letters. There were dispatched 5,428 letters; pamphlets,including reports and bulletins,41,584,and 3,662 packages of seeds of various kinds. During the year 1890, there were received 17,539 letters,and 2,152 samples of grain for examination and report. There were despatched 19,806 letters; reports, bulletins and other circulars of information,218,129,and of seeds, trees,etc., 24,332. The number of farmers on the regular mailing list for reports for the same year was 20,600, to which must be added 4,009 for the special reports on dairying. As this output represents information distributed, no better conception could be gained as to the general volume of work accomplished and

the thoroughness with which the results obtained are distributed throughout the farming community, These data also clearly show the keen interest which is taken in the work by the farmers throughout the country. In addition to their other duties, the various officers carry their work into different centres where special stimulus or information may be needed — where it will prove most useful — distributing through the medium of lectures the results obtained in the laboratory and the field.

At the time of the Indian and Colonial Exhibition, the Director performed an important work in the capacity of Special Commissioner, in making a collection of fruits from all parts of the Dominion, which attracted wide attention.

Among the earliest questions presented for solution was that of the grains best adapted to cultivation in Canada. The valuable results obtained with the Ladoga and Red Fyfe wheats, which secure to the Canadian farmers high grade spring grains of large yield and weight, and with the two-rowed barley, which has proved so superior for malting purposes over the ordinary six-rowed varieties, are in themselves of such importance to the farming community as to justify the establishment of these farms.

The work of the chemical department is almost wholly in the direction of fertilizer, soil and sample analyses, though a limited amount of time has been found for determinations of more pronounced value. Among these we note "The composition of apple tree leaves, being the first of a series of analyses on the apple, with a view to ascertain a rational mode of fertilizing orchards;" a report on "The effect of solutions of copper and iron sulphates, alone and together, on the vitality of the wheat germ."

With the advent of a well-qualified head, the horticultural department has rapidly taken the prominent position which it should hold. It is gratifying to note that the extensive and valuable work undertaken by the late Charles Gibb, relative to the introduction of hardy fruits, is here being continued and extended. The free distribution of fruit trees is a very important feature of the work. During the

year 1890, 100,000 seedling fruit trees were sent to various points, as widely separated as possible, in Manitoba and the North-West. That this work is appreciated, and that there seems to have been awakened an interest in the important question of forestation, is indicated by the fact that there were 1,600 more applications for trees than could be granted. A most commendable feature of the plant and seed distribution is to be found in the clear and concise directions accompanying each package. No more thorough way of distributing much needed information on the subject of tree planting and seed growing could be devised.

The application of fungicides to the treatment of the fungi which prey upon all classes of fruits, receives a large measure of attention. Important work has also been accomplished in the production of new and valuable varieties of small fruits as seedlings and hybrids. In the report of a special committee chosen from the Ontario Fruit Growers' Association and the Montreal Horticultural Society, the statement is made that "The chief attraction to your committee was a patch of two or three hundred seedlings and hybrids (raspberries) which were originated by the Director, some of which, in our estimation, bid fair to supersede the best of the standard varieties."

In the department of botany and entomology good work is also being accomplished. A botanic garden and arboretum has been planned, and a large amount of work has been done upon it. The testing of important forage plants, the study of insects injurious to plants, and the best methods of preventing their action, form the principal features of the work thus far accomplished.

From the outline thus presented, it appears that the Experimental Farm does not fulfil the scientific mission of the European stations, nor does it accomplish both the practical and scientific ends as in the United States. It fills a distinctly different field. As is evidently intended to be expressed by the name, its mission is to reduce to practice the results of scientific research; to perform for the

farming community at large, and within a reasonably short space of time, what would require many years to accomplish if dependent upon individual enterprise and resources; to prove the value of new varieties; to encourage forestry; to test the value of fertilizing ingredients and soils; to disseminate agricultural information of all kinds; to encourage and direct. To this work scientific methods are necessarily applied.

The institution is achieving, in its own way, results of the greatest value to the farming community, and through it to the country at large. The Director and his assistants are deserving liberal support at the hands of Government, and more particularly at the hands of the farmers themselves.

The Birds of Quebec.

Abstract of a Popular Lecture delivered before the Natural History Society of Montreal on the 12th of March, 1891, by J. M. LeMoine, Esq., F.R.S.C.

Part I

The earliest ornithological record in Canada—I might say, possibly in America—occurs in Jacques Cartier's Voyages up the Gulf of St. Lawrence. In chapters ii, iii, vi, vii and xii of the narrative of his first voyage, in 1534, and chapter 1 of his second voyage, in 1535, as well as an entry in the log of Roberval's first pilot, Jean Alphonse, in 1542, mention is made of the myriads of gannets, gulls, guillemots, puffins, eider ducks, cormorants and other sea fowl nesting on the Bird Rocks and on the desolate isles off the Labrador coast. Jacques Cartier goes so far as to say that "the whole French navy might be freighted with these noisy denizens of that wild region without any apparent diminution in their number." (Chap. i–ii, Voyages.) Reliable modern naturalists—Dr. Henry Bryant, of Boston, visiting the Bird Rocks, in 1860, and Charles A. Cory in 1878—confirm these statements of early discoverers as to the number and species of birds to be found in the lower St.

Lawrence. The Jesuit, Le Jeune, in the "Rélations des Jésuites" for 1632, dwells on the multitudes of aquatic birds infesting *Ile aux Oies* (county of Montmagny), and frequenting the shores of our noble river. Friar Gabriel Sagard Theodat that same year furnished in his "Grand Voyage au Pays des Hurons," a list of Canadian birds. In 1636, he notices, among other things, some of the leading species, such as jay, eagle, crane, etc., and has left us a lovely piece of word-painting in his glowing description of the Humming-bird. It was too quaint, too fascinating, not to be preserved. You will find it reproduced at page 217 of my "Album du Touriste." In 1663, Pierre Boucher, governor of Three-Rivers, in an agreeably written memoir, addressed the 8th October, 1663, to Minister Colbert, depicted the birds, mammals, fishes, etc., of New France. This memoir has been recently reprinted by a lineal descendant of the learned and venerable governor, the late Edward F. (Boucher) Montizambert, in his lifetime, law clerk to the Senate of Canada, and father of Col. Charles and Dr. Frederick Montizambert of Quebec. In volume I of Baron la Hontan's "Voyages to North America," published in France in 1703, there occurs an annotated "List of the Fowls or Birds that frequent the South Countries of Canada," and also, a second "List of the Birds of the North Countries of Canada." Father Charlevoix, in 1725, devotes a few pages of his voluminous history to the Canadian fauna. Peter Kalm, the Swedish savant, the friend of Governor La Galissonière and guest at his Chateau St. Louis at Quebec, in an edition of his travels republished in London, in 1770-71, gives plates of American birds and mammals. Thomas Jefferys, geographer to H. R. H. the Prince of Wales, in an elaborate folio volume, issued in London in 1760, devoted a few pages to the birds of Canada. The year 1831 gave us Swainson and Richardson's standard work on the birds of the fir countries, "Fauna Boreali-Americana." In 1853 Hon. G. W. Allan, of Toronto, furnished a list of the land birds wintering in the neighborhood of Toronto. In 1857, a committee of Canadian naturalists, Messrs. Billings, Barns-

ton, Hall, Vennor and D'Urban founded in Montreal a monthly magazine, the *Canadian Naturalist and Geologist*, now the *Canadian Record of Science.* This valuable storehouse of many good things is still of daily reference. Three years later, in 1860, I published at Quebec, under the title "Ornithologie du Canada," in two volumes, the first French work published in Canada on Canadian birds. Professor Wm. Hincks of Toronto furnished, in 1866, a list of Canadian birds observed by Mr. Thomas McIlwraith about Hamilton. In 1868, an industrious entomologist, the Rev. Abbé Louis Provancher, started at Quebec a monthly publication, *Le Naturaliste Canadien*, which he kept up, with a legislative subsidy, for fourteen years. Canadian birds often found a corner in it, though not a large one. In 1883, Mr. C. E. Dionne, the taxidermist of the Laval University, brought out a useful volume, "Les Oiseaux du Canada." Six years later, in 1889, he supplemented it with a "Catalogue des Oiseaux de la Province de Québec." We owe to Messrs. J. A. Morden of Hyde Park, London, Ont., and W. E. Saunders, also of London, Ont., carefully prepared notes on the feathered tribes of Western Canada, whilst a Fellow of the Royal Society of Canada, Dr. J. Bernard Gilpin of Nova Scotia, drew attention to the birds of prey of his native province. In 1881, William Couper published, in Montreal, a valuable little monthly journal, *The Canadian Sportsman and Naturalist,* to which for three years our leading field naturalists and amateurs generally contributed most useful notes and observations. Amongst other valuable records, it contains Mr. Ernest T. Wintle's list of birds observed round Montreal, with discussions and correspondence over the signature of Dr. J. H. Garnier, Mr. Lett and the Rev. Vincent Clementi. In 1886, that veteran field naturalist, Thomas McIlwraith of Hamilton. Ont., published his excellent treatise, "The Birds of Ontario." The book was favorably reviewed in the *Auk* by the eminent Dr. Elliott Coües, who unhesitatingly placed Mr. McIlwraith "in the first place in his own field." I have previously dwelt on the invaluable works on the Canadian fauna by

Mr. Chamberlain, one of the founders of the American Ornithological Union Club. I would be guilty of an injustice were I to fail noticing the numerous contributions to the daily press from a keen Quebec field naturalist, John T. Neilson, who has utilized the rare facilities his outdoor occupations as land surveyor afford him, to study the bird world. Canadian ornithology is also indebted to the late Dr. T. D. Cottle for a "List of Birds found in Upper Canada," in 1859; to H. Hadfield, "Birds of Canada observed near Kingston during the Spring of 1858;" to A. Murray, "Contributions to the Natural History of the Hudson Bay Company's Territories," 1858; to Professor J. R. Willis, "List of Birds of Nova Scotia," 1858; 1870, to J. F. Whiteaves, "Notes on Canadian Birds;" 1873, to A. L. Adams, "Field and Forest Rambles, with Notes and Observations on the Natural History of Eastern Canada;" to Dr. J. H. Garnier of Lucknow, to Prof. Macoun of Ottawa, and many others. The *Bulletin of the Natural History Society of New Brunswick*, the *Transactions of the Ottawa Field Naturalists' Club* have proved useful auxiliaries to the cause of the natural sciences.

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Part II.

It would be about as easy to depict a Canadian winter, without its snow-drifts, as it were to imagine the fleecy plains and solitary uplands of Canada in winter, without their annual visitors, the Snow-bunting—better known to our youth under the appropriate name of Snowbird (*Plectrophanes Nivalis.*)

In New England it is styled the Snowflake; "it comes and goes with these beautiful crystallisations, as if itself one of them, and comes at times only less thickly. The Snowbird is the harbinger, and sometimes the follower, of the storm. It seems to revel, to live on snow, and rejoices in the northern blast, uttering, overhead, with expanded wing, its merry call, 'preete-preete,' reserving, as travellers tell us, a sweet, pleasant song for its summer haunts, in the far north, where it builds its warm, compact nest on the ground,

or in the fissures of rocks on the coast of Greenland, &c." The Snowbird is part and parcel of Canada. It typifies the country just as much as the traditional Beaver.

Thousands of these hardy migrants, borne aloft on the breath of the March storms, come each spring, whirling round the heights of Charlesbourg, or launch their serried squadrons over the breezy uplands of the lovely isle facing Quebec—the Isle of Orleans; one islander alone last spring, to my knowledge, having snared more than one hundred dozen for the Quebec, Montreal and United States markets.

The merry, robust "Oiseau Blanc" is indeed the national bird of French Canada; it successfully inspired the lays of more than one of its native poets. In his early and poetical youth the respected historian of Canada, F. X. Garneau, found in the Snowbird a congenial subject for an ode—one of his best pieces—and the Laureate Frechette is indebted to his pindaric effusion "L'Oiseau Blanc" for a large portion of the laurel crown awarded him by the Forty Immortals of the French Academy.

With the ornithologist Minot, I am quite prepared to recognize the Snowflake as "the most picturesque of our winter birds, which often enliven an otherwise dreary scene, especially when flying, for they then seem almost like an animated storm."

There exists a great variety of color in the plumage of these birds; some, the males perhaps, are more white than the rest, some nearly all white; in others, black and a warm brown is noticeable mixed with the white.

"The black dorsal area is mixed with brown and white, the feet are black, but the bill is mostly or entirely yellowish." Though they seldom perch on trees and are not fond of thickets, but prefer the open country, I have seen flocks light more than once on large trees, elms and others, in the midst of pasture lands at St. Thomas, County of Montmagny.

The eggs, five in number, vary in their coloration, markings and size. The Snow Bunting all disappear from the neighborhood of Quebec with the middle or end of April,

and retire probably to the Arctic regions to build, though we are told that Audubon found a Snowbird's nest in the White Mountains and Maynard certifies to the presence of a flock of these birds at Mount Katahdin, in Maine, early in August, 1869.

The Snow Bunting, common to the continents of America and Europe, occurs in vast flocks in Scotland, England, Russia, and even in Siberia.

Round Quebec it comes as a regular fall and spring migrant: like the passenger pigeon its numbers have sadly decreased of late years.

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That broad-mouthed, long-winged, short-legged, dark bird, with white badges on its wings, is the Night Hawk, or Goat Sucker, *Caprimulgus.* You, no doubt, are aware why he is so persistently called Goat Sucker by naturalists; it is because he never in his life sucked a goat—never dreamed of it. It is one of those outrageous fabrications invented by ignorance, to filch a poor bird of his good name, and which *took root* only because it was oft repeated. In the days of Olaüs Magnus, Bishop of Upsal, in Sweden, few dared to doubt but that Swallows, instead of going to Senegal and the Gold Coast to spend their Christmas and Easter holidays, dived before winter into the bosom of lakes and hybernated under the ice till spring, with no gayer companions than a few meditative trout or other fish. This was an absurd theory, but which had many great names to support and prop it up. The Rev. Gilbert White, in his *History of Selborne,* eloquently demonstrated how absurd, how impossible it was that such a thing could take place.

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I must not, however, forget to point out to you that richly-dressed individual, wearing black and orange badges; that is the Baltimore Oriole. He visits chiefly the Montreal district and Western Canada. Black and orange, did I say? Why that was the official livery of a great English landowner of Maryland, in the days when democracy

amongst our neighbors was not. We have it on the authority of Alexander Wilson, no mean authority, as you know, that this brilliant July visitor took its name from Lord Baltimore, on whose estates a great number of Orioles were to be seen. The *Baltimore Oriole* is a tolerably good musician. You can see how brilliant are the colors of these Canadian birds now exhibited to you!

I think you will agree with me in saying that few countries can furnish a group of brighter ones than those now exposed to view, and composed of Canadian birds only:—Hermit Thrush, Purple Finch, Canadian Gold Finch, Wood Duck, the Golden-winged Woodpecker, or Rain Fowl; Blue Jay; Field Officer; Maryland Yellow Throat: Wax Wing; Indigo Bird; Ruby-throated Humming Bird; Scarlet Tanager; Baltimore Oriole; Meadow Lark; Pine Grosbeak; Cardinal Grosbeak; Rose-breasted Grosbeak, and Towhe Bunting.

As for song, we may safely assert, with the same Alexander Wilson, that the fauna of America can compete with that of Europe; true, we have not the Skylark nor the Blackbird, and the Robin, although very similar to him in notes and habits, is still his inferior; but we have the Wood Thrush, with its double-tongued flute notes, the Hermit Thrush, the Brown Thrush, the gingling, roystering Bobolink, the Canadian Goldfinch, whose warble reminds you of the Canary. The far-famed European Nightingale has certainly met with a worthy rival in the American Mocking Bird, whose extraordinary musical powers have been so graphically delineated by the great Audubon.

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The lecturer commended the study of Ornithology to the young people of his audience in particular, as one of elevating tendency, and, in common with other branches of natural history, calculated to make men better. Lastly, eloquent reference was made to the expediency and need of establishing a chair of zoology in connection with McGill University. The following were his closing words: "We have to admit that the study of natural history in our country has

not been prosecuted with the same vigor as have other departments of science. The outlook might be brighter. The clouds of prejudice hover above, the upas of indifference still lingers below blighting and nipping in the bud, blossoms giving promise of fair fruit. In my humble opinion, what is wanted is a well equipped National Museum worthy of the Dominion, either at Ottawa or in your prosperous, ever expanding city, with some of our millionaires to breathe into the movement the breath of life by the endowment of a chair of Zoology. Your magnificent city has taught other cities that a race of progressive generous men have taken root in the soil, alive to noble duties which the stewardship of wealth imposes. Of such may you well feel proud, on such may I rest some sanguine hopes."

Sir William Dawson, in presenting the thanks of the audience to the lecturer, which had been moved by the Hon. Senator Murphy, seconded by Mr. J. S. Shearer, completely endorsed all that he had said respecting a chair of zoology and a national museum, and hoped the day would arrive when they would be realized. The remarks of Sir William were warmly to the point and as warmly received by the audience.

The European House Sparrow, or, as it is generally called, the English Sparrow (Passer Domesticus.)

W. A. Oswald, Esq., Hill Farm, Belle Riviere, Que.

My object in presenting this paper and group of cliff swallows' nests to the Natural History Society is to show one of the many evils which the English sparrow is doing, by driving some of our most beautiful birds from the country.

The sparrow question is becoming a very serious one, when it is seen that this bird is increasing to an alarming extent throughout the whole country. Up to within the last few years it was chiefly confined to large cities, towns,

and their immediate vicinities; but now there is hardly a farm-yard or dwelling that is not visited by them during some part of the year in search of food or nesting places. Farmers and gardeners are suffering heavy losses annually from its ravages on grain, vegetables and fruit.

The English sparrow was first brought to Canada about twenty years ago. Some colonies were brought to cities in the United States a few years previous to that. These birds were carefully protected and fed for a few years, so that they multiplied rapidly.

Each pair rears two or three broods annually, and an average of four or five young in a brood. They invariably nest near the habitation of man, and, therefore, are free from such enemies as hawks, crows, shrikes, etc., that many of our native birds are exposed to in rearing their young.

Let us take for granted that there are 20,000 sparrows in the city of Montreal and its suburbs at the present time, of which half are males and half are females—which would make 10,000 pairs—and putting the progeny of a single pair at 8 or 10 young in a season, which I believe to be a low estimate, then there would be from 80,000 to 100,000 of an increase in a single season, to spread to the adjoining country, to multiply in the same way. This may serve to give a slight idea of its rapidly increasing numbers. It is hardy and seems to be able to endure the cold winters of Canada, as it does the tropical heat of Australia, and it is becoming a burdensome pest in both of these widely separated countries.

Although it has only been a short time here, yet in the vicinity of villages, flocks of several scores, and even hundreds, are sometimes seen in fields of wheat and oats, while the grain is still green and in the milk state. Besides the kernels actually eaten at this time, it does considerable damage by breaking down the stalks; but as the grain matures, however, far more damage is done by shelling and beating out the heads, so that much more is scattered on the ground and lost than is actually eaten.

Gardeners complain of its ravages on seeds and green peas, while the fruit growers suffer also from its plundering nearly all the different kinds of soft fruit,—but grapes seem to be its favorite fruit.

It has often been stated in favor of the sparrow that they destroy caterpillars, worms and the smaller insects that are injurious to trees and vegetables; but from frequent observations and dissections by experts, it has been proved that while they are young, they are fed partly on insects, but as they reach maturity, their food consists almost wholly of grain,—while it is a known fact that the food of blue-birds, white-bellied swallows, and the cliff swallows, consists entirely of caterpillars, worms, butterflies, moths, and small insects. Yet these are the first birds to be attacked and driven away from their nesting places by the English sparrow, as I stated once before in answer to a question of this kind in the Montreal *Witness*, a couple of years ago. The late Mr. F. B. Caulfield replied to this question, supporting these views.

At one time dozens, and sometimes scores, of cliff swallows' nests might be seen attached under the eaves of farm buildings, almost all joined together, as it were; yet these birds lived in perfect harmony with each other, sallying back and forth from their nests, gliding over the fields in search of food, catching butterflies, moths, and other insects; but since the English sparrow has made its appearance they have taken complete possession of their nests. Not content with one they enter into severe conflicts with adjoining swallows, breaking down their nests, and finally driving away a whole colony of swallows; and the farmer sees to his sorrow, instead of a colony of swallows living happily together with their agreeable and melodious notes, the noisy, quarrelsome sparrows, with their ceaseless, discordant, unmusical notes, making thieving excursions to his fields or barn to feast on his grain; but he never observes it attempt to make a repast on insects.

There are many others of our native birds which are valuable insect-eaters that are being driven away by the English sparrow.

We shoot all we see around the premises, but it is expensive, as there are always new arrivals, especially in the spring and summer time, during the nesting season.

As long as they are allowed to breed unmolested in villages, towns and cities, they will stock and pest the surrounding country, no matter how diligently the farmer may shoot them.

Their extermination ought to be encouraged by premiums being paid for their destruction; and in places where multitudes are congregated together, large numbers of them might be destroyed by shooting, poisoning, or trapping. Laws affording protection to the English sparrow should be repealed, and instead, parties appointed to pay a bounty on all sparrows killed, as well as on all nests and eggs destroyed, thereby helping to free the land from an evil as quickly as possible, before we lose too many of our most beautiful and useful insect-eating native birds, which are a blessing to the farmer, gardener and fruit-grower, and all who depend on them for a subsistence.

The Utica Terrane in Canada.

By Henry M. Ami, M.A., F.G.S., of the Geological Survey of Canada.

Introduction.

The following remarks on the Utica formation in Canada are put forth by the writer, not only in the hope of bringing together and recording a series of facts obtained regarding the history of this interesting formation, but also with the express purpose of arriving at some definite and decided conclusion as to the true horizon and age to which certain slates and associated strata belong, occurring in the highly disturbed and faulted regions of North-Eastern America, which have been referred to several horizons by various writers, and more recently placed in the "Quebec Group" of Sir William Logan—on palæontological, stratigraphical and lithological grounds.

To accompany this essay, or thesis, a table has been

prepared showing the distribution of species known to date from localities where the Utica occurs in Canada, together with comparative lists of species from the same formation in the United States.

H. M. A.

OTTAWA, March 28th, 1892.

THE UTICA TERRANE IN CANADA.

Historical Sketch.—Through the writings of Green, Orton, Rogers, Eaton, Mather, Conrad, Emmons, Hall, Whitfield, Walcott and others in the United States, together with those of Sir William Logan, Billings, Murray, Hunt, Dawson, Chapman, Laflamme, Nicholson and Smith in Canada, the Utica terrane has been fairly well established and defined as marking a distinct horizon or period in the series of strata constituting the Cambro-Silurian or Ordovician Epoch in North America.

Whether it is viewed from a palæontological, stratigraphical or lithological standpoint, the Utica characterizes an epoch in the evolution of this continent which may be readily recognized over wide areas.

First described by New York geologists from exposures of that formation near the town of Utica, N.Y., the *Utica* was defined as a "black and tender rock which reposes upon the Trenton limestone." By some of the early writers it was spoken of as consisting of shaly strata whose total thickness exceeded *nine hundred* feet, whilst by others the very humble, yet perhaps truer estimate, was given of "about seventy-five feet in thickness."

Stratigraphical characters and relations.—Inasmuch as the Trenton limestone is one of the most extensively developed and easily recognized terranes or horizons in America, and inasmuch as the Utica reposes directly upon it without any discordance of stratification whatever, the position of the Utica is therefore likewise easily known and ascertained. Wherever the sequence of Ordovician strata is unbroken, either by faults, foldings or denudation, from the Potsdam to the Hudson River, the presence of the Utica has been

observed,[1] its fossils recognized, its bituminous strata detected, and its position is everywhere the same between the Trenton (below) and the Hudson River (above).

The following table indicates the sequence of terranes in Canada during that portion of Palæozoic times when no break whatever occurred in the deposition of marine sediments, when life progressed and flourished in the quiet depths of the Ordovician seas or along their shores. The relative position of the Utica is herein also indicated. These Ordovician terranes are numbered from 1 to 7 in the natural order in which they were deposited :—

7. Hudson River (= Lorraine).
6. Utica.
5. Trenton.
4. Bird's Eye and Black River.
3. Chazy.
2. Calciferous.
1. Potsdam.

The remarkable continuity of the Trenton limestone, so abundant in fossil remains, and so uniform in its mode of occurrence and deposition throughout the Provinces of Quebec and Ontario in Canada, is admirably kept up in the succeeding Utica terrane, whilst the next higher terrane—the Hudson River—also presents similar characters of continuity, uniformity in sedimentation, life, and in lithological characteristics. Coming in between the Trenton and Hudson River terrancs the Utica is essentially a transitional series of strata, a link in the chain of terranes above noted.

The following is a section of a portion of the lower Utica strata as they were observed on Crichton street, New Edinburgh, near Ottawa, during the excavation for waterworks purposes in 1887 :—

	Feet.	Inches.
1. Dark grey bituminous limestone band holding *Leptæna sericea*, Sowerby and other species....	0	9
2. Soft, friable, purplish black disintegrating and fossiliferous shales holding abundance of *Orthis testudinaria*, Dalman, bleached, and *Leptæna sericea*, Sowerby, and *Asaphus Canadensis*, Chapman	0	8

[1] This is true of Ontario, Quebec and New York State especially.

3. Unevenly bedded impure bituminous limestone band with *Asaphus Canadensis*, Chapman, *Orthis testudinaria*, &c.	0	7
4. Soft, friable and brittle shales, with abundance of fossil remains—*O. testudinaria, L. sericea*, &c.	0	2¾
5. Light grey band of impure limestone, bituminous, and holding *Conularia Trentonensis, Leptæna sericea, Asaphus Canadensis, O. testudinaria*, &c.	0	4
6. Thin, irregular and unevenly bedded soft friable shales which disintegrate readily, teeming with fossils which appear bleached or white on the brownish-yellow weathering grey shales holding *L. sericea* and *O. testudinaria* in abundance.	0	1½
7. Black bituminous impure limestone with *Leptæna sericea, Orthis emacerata, Asaphus Canadensis*, &c.	0	8
8 Black bituminous shales holding abundance of trilobitic remains, especially those of *Asaphus Canadensis*. Resembles that band which crops out along the Rideau River shore near the Rifle Range	1	2
9. Band of impure, highly bituminous limestone, black in colour, with irregular splintery and at times conchoidal fracture, holding remains of *Asaphus Canadensis, Endoceras proteiforme, Strophomena alternata*, Conrad	0	11
10. Black, bituminous and somewhat splintery brittle shales. Amongst the species of fossils observed there were: *Leptograptus flaccidus*, Hall, (?) *Sagenella ambigua*, Walcott, *Conularia Trentonensis, Leptæna sericea, Schizocrania filosa*, Hall, *Leptobolus insignis*, Hall, *Endoceras proteiforme*, var. *tenuistriatum, Asaphus Canadensis, Primitia Ulrichi*, Jones, &c.	0	7
	6	0¼

It would thus appear that we have shales and limestones interstratified with each other in this portion of the Utica, showing the intimate and close relationship to the underlying Trenton. A summary of the above section gives us :—

SUMMARY OF SECTION AT NEW EDINBURGH.

	FEET.	INCHES.
1. Limestone	0	9
2. Shales	0	8

3. Limestone	0	7
4. Shales	0	2¾
5. Limestone	0	4
6. Shales	0	1½
7. Limestone	0	8
8. Shales	1	2
9. Limestone	0	11
10. Shales	0	7
	6	0¼

Lithological characters.—The Utica terrane is essentially a *shale* formation, whence the designation "Utica shale" which numerous writers have applied to it. It is chiefly composed of shales and limestone, dark in colour and sometimes highly bituminous.

Whilst the uppermost measures of the Trenton formation are characterized by calcareous strata interstratified with shaly bands which increase in number and extent as we pass upward from the Trenton to the Utica, similarly, the lower measures of the Utica consist of shaly strata interstratified with calcareous or limestone bands, all of which are bituminous in character.

The accompanying sketch taken at New Edinburgh, Ottawa, along the right bank of the Ottawa River, shows the character of the strata at the summit of the Trenton and in the basal beds of the Utica:—

These characters of the upper Trenton and lower Utica point clearly to a subsidence which occurred towards the close of the Trenton and led to the deposition of finely divided muds and clays. The change in the nature of the sediments led to a change in the forms and characters of the fauna or life of this old Ordovician sea, so that new forms of animal life were ushered in, in these pelagic depths, which will be discussed later on.

The presence of many of these organic forms led to considerable change in the character of the strata as we find them at the present day. Graptolites and trilobites in great abundance characterize the Utica, and the shales are highly impregnated with bituminous materials from

which petroleum and oils can be extracted, but scarcely yet with sufficient readiness and cheapness to warrant the utilizing of these shales for economic purposes.

The shales of the Utica are for the most part soft dark-brown or black, brittle, earthy and bituminous. From the exposures of this formation as far east as Murray Bay, Que., along the north shore of the St. Lawrence in the vicinity and under the waters of Lake St. Peter; at Montreal, Lacolle, Clarenceville; and again between Lake Ontario (Whitby) and Collingwood Bay, near Collingwood, as also along the capes and bays of the great Manitoulin and other islands in the northern portion of Lake Huron, the shaly strata of the Utica are very similar throughout and the characters very closely related.

In certain areas they are more or less calcareous, at times they are highly argillaceous. The presence of volcanic and intrusive masses about Montreal, and in the Eastern Townships of Quebec, has considerably altered and hardened the Utica of that region, which is, as a rule, highly calcareous.

Chemical characters.—In the "Geology of Canada," 1863, Sir William Logan has given a number of interesting chemical analyses of the Utica shales or "pyroschists," as they are called, which were made by Messrs. Chandler and Kimball for Prof. Whitney, and were published in the "Geol. of Wisconsin," Vol. I, p. 184.

The five analyses there given are here inserted, as they serve to show clearly the chemical composition of these shales or pyroschists from various localities. They are as follows:—

"I. is a blackish-brown, very fine-grained rock, from Cape Smith, Lake Huron. It has a somewhat conchoidal fracture, is not schistose in its structure, and contains no traces of fossils. II. is from an Island north of Maple Cape, and is blackish-brown, fine-grained, and earthy in texture, with a laminated structure, and contains no fossils. III. is from Ste. Anne, Montmorenci, and is dark-brown, shaly, and contains graptolites. IV. is from Gloucester, and is a

black shale filled with fragments of trilobites and crinoids. In these analyses the carbonates of lime and magnesia, with the alumina and oxide of iron, were removed by solution in acids, and the elements of the organic matter determined in the insoluble portion.

	I.	II.	III.	IV.	V.
Clay and sand...........	38·45	34·60	37·26	48·27	73.57
Carbon.....................	6·83	6·63	·61	6·99	15·08
Hydrogen.................	·74	·77	·83	1·13	1·65
Oxygen....................	3·20	2·96	1·71	3·39	5·39
Carbonate of lime........	45·02	49·31	52 60	20 30	1·29
Carbonate of magnesia...	2·09	2·53	3·42	11·48	·76
Alumina and oxide of iron.	2·16	2·09	3·29	7·99	2·79
	98·49	98·89	99·72	99·55	100·48

"The analysis V in the above table is that of a pyroschist from this formation, in the lead region of Wisconsin."

The first *four* analyses are made from Canadian specimens, and give us a sufficiently typical series from remote outcrops of the Utica terrane, from which the lithological and chemical characters of the rock may be ascertained.

Mineralogical characters.—The minerals which characterize the Utica are not numerous, but it may be stated here that *iron pyrites* is tolerably abundant in the middle beds of the Utica, about Ottawa where it occurs in masses from the size of a man's fist to smaller dimensions, and often replacing entirely or simply coating organic remains, such as orthoceratites, trilobites, graptolites and sponges.

Strontianite has also been observed, determined and recorded by Dr. B. J. Harrington from the Utica shales of St. Helen's Island, opposite Montreal, Que.

Selenite.—A variety of gypsum occurs in fine scales or flakes either coating organic remains or between divisional planes of stratification as a secondary product of the decomposition of iron pyrites.

The Utica, except in its lowest measures, does not afford any building stone of any consequence.

A few of its calcareous strata, close to the base of the formation, might be utilized for building purposes, but they

are usually too thin or nodular and easily disintegrating to be of any commercial value.

Some bands, however, are magnesian and calcareous and break with a conchoidal fracture. These might very reasonably prove to be useful for cement or hydraulic purposes.

The bituminous character of the shales of this terrane induced a company to start operations at the village of Windsor, near Collingwood, Ont., for the purpose of extracting oil (petroleum) from these shales, but the process proved too costly and the work was abandoned. The shales used are reported to have contained an average of 8 per cent. of petroleum. The specimens collected by Mr. A. S. Cochrane, C.E., at the works, showed the shales to be highly fossiliferous.

The basal beds of the Utica have been described as consisting of interstratified bands of limestones and shales which gradually pass upward into shales exclusively as the middle portion of the terrane is reached. These middle beds consist for the most part of shales, dark-brown weathering and black along a fresh fracture, which become more or less compact in certain places, whilst many beds have a decided conchoidal fracture. They are rich in graptolites and trilobites, especially of the genera *Lepto graptus* and *Triarthrus* respectively. The uppermost beds of the Utica, so far as they are known to the writer, show a strong tendency to become argillaceous and magnesian, especially in the Ottawa Palæozoic Basin. They consist of very thin and fissile, soft argillaceous shales, evenly bedded and rather destitute of fossils. They pass upward into the Hudson shales and strata whose lower measures are highly magnesian, as can be seen from the bright buff weathering character of the Hudson River rocks along the line of the Canada Atlantic Railway, near Ottawa and elsewhere.

The total thickness of the three subdivisions of the Utica, thus differentiated on lithological as well as other grounds, has nowhere been seen by the writer to exceed one hundred feet, but is usually much less.

Palæontological characters.—The Utica formation along the whole line of its outcrop in Canada may be said to be for the most part highly fossiliferous. This is especially true of the lower and middle portions of this terrane, *i.e.*, of those portions which are more calcareous than the upper series of strata. In the "Palæontology of Ontario," 1874, by Prof. A. H. Nicholson, that writer describes and records *eleven* species of fossils as constituting the fauna of this period in Cambro-Silurian times. In 1882, when the writer joined the Geological Survey staff, there were then exhibited in the cases of the museum some twelve species of fossils representing the then known fauna of the Utica.

By dint of collecting and gathering together the material which was in the possession of the Geological Survey of Canada, determining the same, and of losing no opportunity of collecting himself wherever the Utica formation was known or seen, the writer has been able to bring together an assemblage of upwards of sixty forms which marks a special horizon in Ordovician times and differentiates itself from the Trenton and Hudson River terranes. The fossils which are found entombed in the shales and limestones of this formation are often exceedingly well preserved, and being very abundant afford an excellent opportunity of studying the fragments or separate portions of individuals which are usually seen along the divisional planes of stratication in such vast numbers.

Just as the lithological characters of the Utica show a decided resemblance and similarity to the underlying Trenton and overlying Hudson River, so also the fossil remains of the Utica towards the base of that terrane show a decided affinity and close relationship to the Trenton *facies*, and towards the summit to the newer Hudson River fossils. In fact, we find that just as there are passage beds, or transitional strata, between the Trenton and Utica, and also between the Utica and Hudson River, so also do we find a number of species of fossils which pass upwards or are common to the three formations.

The following table has been prepared to show the

different species which have, so far, been recognized in Canada by the writer as common to the Utica and Trenton and to the Utica and Hudson River, pointing out, besides, the forms common to the Trenton and Hudson River terranes :—

TABLE SHOWING THE SPECIES OF FOSSIL REMAINS COMMON TO THE TRENTON AND UTICA, TO THE UTICA AND HUDSON RIVER, &c.

	GENERA AND SPECIES.	Trenton.	Utica.	Hudson Riv.
1..	*Monotrypa undulata*, Nicholson	*	·	*
2..	*Discina Pelopea*, Billings	*	*	·
3..	*Lingula quadrata*, Eichwald	*	*	·
4..	*Leptæna sericea*, Sowerby	*	*	*
5..	*Strophomena alternata*, Conrad	*	*	*
6..	*Orthis testudinaria*, Dalman	*	*	*
7..	*Platystrophia biforata*, v. *lynx*, Eichwald	*	*	*
8..	*Orthis emacerata*, Hall	*	·	·
9..	*Zygospira Headi*, Billings	·	*	*
10..	" *modesta*, Say	·	*	*
11..	*Anazyga recurirrostra*, Hall	*	*	·
12..	*Rhynchonella increbescens*, Hall	*	*	·
13..	*Serpulites dissolutus*, Billings	*	*	·
14..	*Modiolopsis modiolaria*, Conrad	·	*	*
15..	*Orthodesma parallelum*, Hall	·	*	*
16..	*Pterinea insueta*, Conrad	·	*	*
17..	" *Trentonensis*, Conrad	*	*	·
18..	*Conularia Trentonensis*, Hall	*	*	·
19..	*Bellerophon bilobatus*, Sowerby	*	*	*
20..	*Plunotomaria subconica*, Hall	·	*	*
21..	*Murchisonia Milleri*, Hall	*	*	·
22..	*Endoceras proteiforme*, Hall	*	*	*
23..	*Asaphus platycephalus*, Stotts	*	*	*
24..	*Triarthrus Becki*, Green	·	*	*
		17	22	15
		In common.		
		15		13

The palæontological characters of the Utica are exceed-

ingly varied, the forms of life entombed in its strata belonging to almost all the classes of the Palæozoic fossils. No evidence of plant or fucoidal remains has been detected in the Utica of Canada.

The mode of preservation of the fossil remains is similar to the manner in which most fossils are preserved in shales or finely divided clays and sands throughout palæozoic strata. The calcareous portions of the shells of brachiopoda, lamellibranchiata and cephalopoda, are preserved as such, but iron pyrites often replaces the lime, whilst the chitinous structure of crustaceans, graptolites, etc., is also replaced by iron pyrites in numerous instances.

Amongst the most characteristic species which distinguish this terrane from others, we find that trilobites play no unimportant part. In the lower half of the formation *Asaphus Canadensis*, Chapman—which may probably be identical with Hall's A. latimarginatus described in 1847—may be said to be very abundant indeed. Thousands of fragments of different sized individuals occur, which, when restored, would form individuals ranging from one inch to ten inches and more in length. The genus Triarthrus is also most characteristic of the Utica. In Canada the following forms occur: *T. Becki*, Green, *T. glaber*, Billings, *T. Canadensis*, Smith, and *T. spinosus*, Billings. Embryonic forms of this genus are very abundant in certain portions of the middle Utica about Ottawa, and a suite of specimens has been obtained, with few exceptions, similar to that obtained by Prof. Walcott, of the U. S. Geol. Survey, who has so admirably described the Utica of the United States and illustrated *Triarthrus Becki* in his " Utica and related formation " published in 1879.

Triarthrus glaber is characteristic of the Utica outlier in the Lake St. John region, Quebec, whilst *T. Canadensis*, with its peculiar genal angle produced into a prominent spine on each side of the head, is most abundant in the Utica shales of the islands in the northern portion of Lake Huron, such as the islands north of Maple Cape, &c.

Triarthrus spinosus occurs intimately associated with

T. Becki in the Utica of the Ottawa Palæozoic Basin, in the County of Carleton. It was armed with numerous spines both on its head and body, besides tubercles or blunted spines on the occipital segment and on the pygidium.

Besides these trilobites vast numbers of the remains of *Ceraurus pleurexanthemus* occur in the shaly strata which crop out south of Rochesterville, Ottawa, between that village and Carling Lake. This form occurs here associated with *Asaphus Canadensis* and *Triarthrus Becki*, Green. In the calcareous bands of Montmorenci, Pointe aux Trembles, Ottawa, Whitby and Collingwood *Calymene senaria* occurs in tolerable abundance, but usually in detached fragments, the cephalon and pygidium only, being usually preserved. Amongst the cephalopoda, may be mentioned shells of *Endoceras proteiforme* showing the large size and tapering character of the *endosiphon* as it is flanked all around and on each side of the septate or camerate portion of the shell. Individual specimens of this species have been found in the Utica of Gloucester and Ottawa whose probable length, when perfect, was not less than six feet. Thousands of small orthoceratites usually referred to the genus Endoceras :—E. *proteiforme*, *var tenuistriatum*, etc., etc., are also found throughout the Utica from Murray Bay and Lake St. John to Whitby and the islands north of the Great Manitoulin Island.

These individuals resemble closely the form described by Professor Hall as *O. lamellosum*, and as they are found appear to be true representatives of the genus Orthoceras. The shell in the younger examples must have been exceedingly delicate and thin from the mode of preservation.

These Orthoceratites are pre-eminently characteristic of the Utica.

The Glossophora or Gasteropoda are not numerous but interesting. As a rule they are crushed and preserved as casts. In a few instances the lines of growth and sculpture is shown with considerable precision.

Amongst the Lamellibranchiata we find such genera

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as Pterinea and Modiolopsis represented. *Pterinea insueta*, Conrad, young individuals or a variety of the type species, also *Modiolopsis modiolaris*, Conrad, occur in tolerable abundance, but *Lyrodesma pulchellum*, Emmons, may be said to be the commonest and most characteristic of this class in the Utica terrane.

Of the brachiopoda—*Leptaena sericea*, Sowerby, *Orthis testudinaria*, Dalman, and *Strophomena alternata*, Conrad, are found in the lower Utica shales almost everywhere; but one of the most characteristic forms of this interesting class is the minute, though abundant, *Leptobolus insignis* of Hall.

Billings had observed its presence in the Montmorenci section and referred to it as a small *Discina*. On a small slab—the size of one's hand—there may be counted sometimes as many as twelve individuals—all in a tolerably good state of preservation—and presenting the characters of the genus remarkably well At Murray Bay, Lake St. John, Montmorency—around Quebec, at Montreal, Ottawa, Gloucester, Whitby, Collingwood, etc., this form occurs in almost every collection made and serves as a very good indicator of the presence of the Utica. Small individuals of *Zygospira modesta*, Say, are also very characteristic and intimately associated with the previously mentioned species. The Utica representatives of this species are rather diminutive, some individuals being scarcely more than one or two millimetres in length, and indicate or present the protegulum very markedly in such nepionic forms as we find especially about Ottawa.

Amongst the most interesting of the brachiopoda however, *Siphonotreta Scotica*, Davidson, marks a very interesting horizon. One single individual of this species, alone, was found by the writer amongst the numerous collections of brachiopoda gathered together by the late Mr. Billings. To Mr. J. W. H. Watts, of the Ottawa Field Naturalists' Club, and to Mr. Whiteaves is due the honour of discovering and making known this beautifully ornamented and setate tretenterate brachiopod. In a paper prepared by the writer and read in the winter of 1887, entitled: "*Notes on and the*

precise Geological horizon of Siphonotreta Scotica, Davidson." I had occasion to note the exact band from which this interesting fossil camo and gave a list of sixteen other species which were found associated therewith. Since then I have had the good fortune to obtain additional forms, associated with which is the *Turrilepas Canadensis*, Woodward—described by Dr. Henry Woodward in the "Geol. Mag. No. 300, Dec. 3," vol. vi. p. 271 (1889.)

The following is a list of the species occurring in the 'Siphonotreta band" along the bank of the Rideau River, opposite the Rifle Range, Ottawa :—

1. *Batostomella erratica*, Ulrich.
2. *Lingula curta*, Hall.
3. " *elongata*, Hall.
4. " *quadrata*, Eichwald.
   (? = *L. Cincinnatiensis*, Hall and Whitfield.)
5. *Leptæna sericea*, Sowerby.
6. *Strophomena alternata*, Conrad.
7. *Orthis testudinaria*, Dalman.
8. *Zygospira Headi*, Billings.
9. " " var.
10. " *modesta*, Say.
11. *Conularia Trentonensis*, Hall.
12. *Leperditia cylindrica*, Hall.
13. *Beyrichia oculifera*. Hall.
14. *Asaphus Canadensis*, Hall.
15. " *platycephalus*, Stone.
    vel. *A. megistos*, Locke.
16. *Calymene senaria*, Conrad.

The above sixteen species all occur in the one band, from nine inches to one foot in thickness, associated with (17) *Siphonotreta Scotica*, Davidson, and (18) *Turrilepas Canadensis*, Woodward.

The Lingulæ are eminently characteristic, especially *Lingula Progne* and *L. curta*, the former of which is abundant almost everywhere the Utica shales holding *Asaphus Canadensis* occur.

The monticuliporidæ and Bryozoa generally have afforded but little material as yet. *Batostomella erratica*, Ulrich, has been recognized and identified by Prof. E. O.

Ulrich, of Newport, Ky., U.S.A., whilst an obscure form allied to Arthronema occurs in certain shaly strata of Rideau Ward, Ottawa. The GRAPTOLITES are eminently characteristic of the Utica. The most common species is the *Orthograptus quadrimucronatus*, Hall, which is found almost invariably in all collections of the Utica. Then *Leptograptus flaccidus* comes next. With the graceful and slender curving stipes of the polypary the surfaces of many slabs of Utica shale are literally covered. Another species of this genus, *Lept. annectans*, Walcott, has been found in one or two localities. The genus *Climacograptus* has also one representative at least, and *that* a form closely related to C. Scharenbergi, Lapworth, or *C. teretiusculus*, Hisinger. Considerable difficulty has been met in identifying this Climacograptus, and especially on account of the fact that the earlier types and descriptions in many instances included several forms quite separate and distinct in structure, whose affinities have yet to be discussed and characters ascertained. Several small specimens of a diprionidian graptolite occurs abundantly in the Utica shales of Collingwood, Whitby, Ottawa, Montreal, &c., and is usually referred to the ubiquitous *Diplograptus pristis*, Hisinger. *Reteograptus* (?) *Eucharis*, Hall, another curious and interesting form, whose relations and affinities are still obscure, has been met with at Montreal in the Utica of St. Helen's Island, and resembling closely the forms from the typical locality Lake St. John basin.

The obscure parasitic hydroid ? *Sagenella ambigua*, Walcott, has been detected on the shells of several orthoceratites, but the identification of this form is very dubious.

Referring to parasites, a small *Cornulites*, *C. immaturum*, Hall, has also been found in the Utica of Montreal by Mr. Thos. Curry amongst the *débris* hauled up from the bottom of the harbour whilst the excavations were going on for the 28-foot channel. The material there obtained has kindly been placed at my disposal by Sir William Dawson, and amongst the forms detected the last mentioned proved to be

an interesting addition to the fauna of the Utica. *Serpulites dissolutus*, Billings, has also been found in several localities.

A fossil sponge—*Stephanella sancta*, Hinde, has recently been described from the Utica shales of Ottawa in the Geol. Mag., new series, Dec. III, vol. viii, No. 1, for January, 1891, pp. 22-24, in a paper entitled : "*Notes on a new Fossil Sponge from the Utica shale formation* (*Ordovician*) *at Ottawa, Canada.*" This sponge proved to constitute a new and very simple type of a Lithistid sponge—whose spicules resemble closely those of the modern *Tethœa*—many specimens of which occur in the Post-Tertiary clays of the Ottawa and St. Lawrence river basins.

Geographical Distribution.—Having glanced at the stratigraphical relations of the Utica terrane and at its lithological as well as chemical constituents, then surveyed over in a general way the palæontological characters, let us look for a moment at the geographical distribution of the same in Canada.

In the Province of Quebec, the Utica is first met in the East in loose blocks and specimens brought up on the north shore of the Island of Anticosti by floating ice. There is scarcely any doubt that the Utica shales occur in their proper and natural position between the Trenton and Hudson River terranes—in the unbroken and fine sequence of Ordovician strata northwest of Anticosti—and that on account of their soft, brittle and easily denuded character they have been washed and carried away from that section now occupied by the north channel of the St. Lawrence River. But the most easterly outcrop of the Utica as yet recorded *in situ* occurs near the mouth of the Murray River, Murray Bay—where Mr. W. F. Ferrier made an interesting collection of fossils which were determined and described by the writer in the "Can. Record of Science" for 1887, pp. 101-107. The paper is entitled : "*Notes on Fossils from the Utica Formation at Point-à-Pic, Murray River, Murray Bay* (*Que.*), *Canada.*" In this paper twelve species of fossils were noted, as follows :—

1. *Diplograptus* sp. (resembling *D. pristis*, Hisinger.)

2. *Pachydictya* sp.
3. *Leptobolus insignis*, Hall.
4. *Siphonotreta* sp.
5. *Leptæna sericea*, Sowerby.
6. *Orthis testudinaria*, Dalman.
7. *Trocholites ammonius*, Conrad.
8. *Endoceras proteiforme*, Hall.
9. *Triarthrus* sp.
10. *Calymene senaria*, Conrad.
11. *Leperditia* (*Primitia*) *cylindrica*, Hall.
12. " probably n. sp.

The Utica terrane occupies a more or less narrow and continuous belt along the north shore of the St. Lawrence from Cape Tourmente below Quebec, to Montreal, whence the belt trends to the south and is seen in the neighbourhood of Lacolle, Clarenceville, etc.—then crossing the boundary line—rounding the edge of or skirting the Adirondack range—to reappear north of Lake Ontario at and in the vicinity of Whitby—it crosses the Province to Collingwood where it again disappears beneath the waters of the Georgian Bay and continuing north and west strikes numerous points, capes and islands about the great Manitoulin Island dying out to the west and overlaid by newer and overlying formations.

In the vicinity of Quebec the Utica terrane is met at several localities. Characteristic species were collected by Rev. Prof. Laflamme, Mr. St. Cyr, Mr. T. C. Weston, Dr. Ells and the writer within recent years, at Montmorenci, Beauport, St. Charles River Flats, Charlesbourg, half-mile west of Charlesbourg, at Grondines, Pointe aux Trembles and Cape Santé, and also across the river at St. Antoine [de Tilly] interesting collections were made.

At Montmorenci Falls, near the bottom of the falls and ravine the following characteristic Utica fossils were collected and detected by the writer and Dr. Ells:—

1. *Orthograptus quadrimucronatus*, Hall.
2. *Diplograptus* sp.
3. *Climacograptus* sp.
4. *Reteograptus ? Eucharis*, Hall.

5. *Lingula curta*, Hall.
6. *Leptobolus insignis*, Hall.
7. *Leptæna sericea*, Sowerby.
8. *Triarthrus Becki ?* Green.

Near the mouth of the Montmorenci River—close to the Railway Bridge—the following species occur :—

1. *Diplograptus* sp. indt.
2. *Climacograptus* sp.
3. *Orthograptus quadrimucronatus*, Hall.
4. *Leptobolus insignis*, Hall.
5. *Endoceras proteiforme*, Hall.
6. *Triarthrus Becki*, Green.

Along the Beauport shore the following species were obtained by Mr. D. N. St. Cyr, a devoted and zealous naturalist at the Museum of the Department of Public Instruction, Quebec :

1. *Schizocrania filosa*, Hall.
2. *Leptæna sericea*, Sowerby.
3. *Lyrodesma pulchellum*, Emmons.
4. *Endoceras proteiforme*, Hall.
5. *Asaphus Canadensis*, Chapman.

At Charlesbourg village—along the road from Quebec to Charlesbourg and a few yards south of the church—the following forms were collected by Dr. W. Ells, Prof. Laflamme and the writer, in light coloured, calcareous shales :—

1. *Leptograptus flaccidus*, Hall.
2. *Strophomena or Rafinesquina* sp.
3. *Leperditia cylindrica.* Hall.
4. *Triarthrus Becki*, Green.

But along a brook—about one mile west of Charlesbourg village, on the road to Lorette, the black bituminous shales of the Utica are seen to crop out and afforded the following characteristic forms :—

1. *Orthograptus quadrimucronatus*, Hall.
2. *Climacograptus* sp.
3. *Leptobolus insignis*, Hall.

All these are typical Utica fossils.

(*To be continued.*)

ANNUAL PRESIDENTIAL ADDRESS.

NATURAL HISTORY SOCIETY, 1892.

The duty of delivering what is called the Presidential Address falls this year on probably the most useless President that has ever had the honour conferred on him of sitting in the Presidential Chair of the Natural History Society of Montreal.

The fault however is not wholly mine, if indeed any real blame can be attached to my name in connection with the office.

No Natural History Society has as yet discovered a natural law, or even traces of a natural law whereby the grandest object of Nature, Man, can plead with sickness the positive urgency of Presidential position, and thereby obtain a six months lease of steady health.

For close on three months out of the six active months of this Society's work I was an "ailing man," barely able to fulfil the necessary duties of my profession, and wholly unable to fulfil any of the duties that fell to my lot as President of this or other Societies.

I also told the gentlemen who urged me strongly to accept the position that my professional duties were of that nature that no outside appointment could stand in the way of, clergymen as well as doctors being subject to sudden and pressing calls before which everything must give way.

Hence apart from ill health I have been forced to refrain from duties that in themselves would have proved a pleasure. Not because I loved the Natural History Society less, but because I loved my profession more.

With these words of apology, and direct warning as to future presidential elections; I would proceed with my address, carrying with me, I trust the good natured pardon or sympathy of the officers and members of this Society.

With regard to the working of the Society for the year I have but little to say, as the reports of the council about

to be read, taken with those of the curator, editing committee and librarian, furnish in a direct and forcible manner the facts connected with another year of this Society's progress.

There is no question that this Society has connected with it some singularly active members, that its aims are ever good; and that its influence is sufficient to arouse a prophetic spirit in its most faithful members as to the possibilities of its future.

If some of those large hearted and public spirited gentlemen, whose boundless munificence is fast making our city a magnificent educational centre, would only place the Natural History Society on their list of educational institutions worthy of being enquired into as a possible future field for their liberality, the higher educational influences of the city would unquestionably receive a much needed and admirable addition.

The true destiny of a society such as this should be that of centreing within its field of operation those *aids* to study which would illustrate to the eye and ear and mind of the hundreds of students who throng our colleges and schools, the direct instruction of their scientific and literary teachers, and which would also constantly create a desire in the minds of others who are not students, to seek to improve themselves through the impetus to study which a well equipped Natural History Society would hold out to them. Our aims as I said are admirable, namely "the study of Natural History, General Science and Literature" but none I fancy would claim that the work of the Society has ever permanently reached the aims set forth in our act of incorporation. The record made by the Society since its foundation has been in every way creditable and fully up to the limit of its financial opportunity; but whilst other educational institutions once weak and ineffective, have been developing with rapidity their original aims, and gathering about them the well earned lustre which ever comes from increasing success, our society can scarcely claim a proportionate advancement, as the "Sure yet Silent Years pass on."

We are a "Natural History Society," and up to the limit of our opportunity I hold a successful one, but we were created just as much a Society for the Study of General Science, as a Society for the Study of General Literature; and as far as my knowledge goes both these latter aims can scarcely be claimed as forming part of our corporate active life and existence.

And yet our city abounds with scattered societies many of them private, others semi-public and others public; which have started into existence to meet what their members considered positive, scientific and literary needs and that wholly apart from the Natural History Society incorporated for the very purpose of seeing those needs supplied.

One could easily understand this if our city were the size of London or New York, but with a population such as ours it does seem a pity that scattered societies should positively be doing the work that our act of incorporation has created us to do, and are doing it wholly apart from our society, and in some cases without the slightest knowledge that such work forms part of the work that our society was incorporated to perform.

Of course such a fulfilment of original aims, demands an expenditure far beyond our present income, and an expenditure that would not be just or business-like under the present conditions of our life. But there is no condition of life in this busy world of progress that cannot be improved, and it does seem to me that the time has come when this honored society should emerge from the almost "Classic Shades" of its existence, into that bustling life of educational competition which working out its destiny in the public arena "on which ten thousand eyes are fixed" has already in connection with other institutions caught the attention, rivetted the thought, and won the noble gifts of noble hearted and generous men, who regard the educational improvement of a country as all important, and have proved their regard by acts of princely munificence. But then these institutions were always "in evidence" before the

public, ever stating their needs, ever enlarging their needs, ever holding out hands to catch the drops that heaven might send them, until at last importunity, the reward of just demands prevailed, and the golden shower poured down to feed the thirsty ground. In this busy competitive age, next in value to existence itself is that of giving evidence —ceaseless, untiring evidence, of your existence.

No one standing to-day on the steps of the original McGill College remembering what it was 25 years ago and seeing what it is to-day can fail to realize the inestimable value of keeping the needs of an educational institution clearly and distinctly before the public. Admit as Montreal may gratefully and proudly do, the force and power that McGill has gathered to itself through its right to claim as its presiding genius such a brilliant world-known guide as Sir William Dawson, admit to the full the magnificent staff which in all the branches of the University group themselves around him; —all such admissions do not fully explain the phenomenal success of the institution for much of it must in fairness be explained by the fact that McGill *has aimed high*, and has ceaselessly and with dogged persistency kept its aims before the public.

Now the Natural History Society is an educational Society or it is nothing, and it ought to be righteously within the admitted field of "higher education," otherwise it has largely failed in reaching the object of its existence.

If one in this prosaic age might indulge in "day dreams" my dream as to the future of this Society would be something like this. A building worthy of Montreal as the Great Educational Centre of Quebec, and the Provinces, suited to the educational spirit of the times in which we live, and sufficiently large to gather under its roof in generous affiliation all the leading literary and scientific societies of our city which now are leading independent lives. A free library for study and reference, in connection with the three fold objects of our existenee—Natural History, General Science and Literature,—ample room for private study—every inducement held out to the students of our Colleges

and the young life of our city to avail themselves of the privileges open to them. A museum that for teacher, student and enquirer alike would prove its worth as years roll on. Courses of free class lectures on Natural History, General Science and Literature by competent lecturers and Certificates of honorable proficiency for those who attending them earn by examination the just reward of their labors. Free popular lectures that might act as incentives to lure the young to higher and closer studies, and last though by no means least—a governing body, large, comprehensive and broad minded in its views; full of zeal and energy in grasping new ideas and fresh born thoughts, and realizing to the full that they have a great public educational work to do, and that the leading recipe for obtaining their aims is that of ceaselessly and with dogged persistency keeping the Natural History Society of Montreal before the public.

I know that such a scheme may fairly be regarded as visionary—but the world owes not a little to visionaries, and in this case the original visionaries were the honored founders of the Natural History Society itself. They founded a Society for the cultivation of Natural History, General Science, and Literature, and we to-day are the representatives of these high original aims. We can hold them in safe keeping and pass them on like the "whispered traditions of the hoary past" to those that will come after us, or we can grasp them with that touch of daring enterprise, which is largely characteristic of the age in which we live, and facing the public with claims as loudly lettered as those of less useful institutions, seek to gain our share of that munificent liberality for which our city is fast becoming renowned.

I am sure that you will pardon one for thus speaking on the aims and possibilities of a Society for which he has been enabled to do so little, and in whose work he has taken so small a part. But the fault has been yours, gentlemen, for it was you who placed me in the position to quote these words with which as the "Shadow of a Shade" of a Ghost

like President, I close this address,—and the words are these:

> "Aim high
> "For most aim low and fail.
> "Aim as thy Fathers aimed
> "Who won the vantage ground thou standest on."

PROCEEDINGS OF THE NATURAL HISTORY SOCIETY.

MONTREAL, March 28th, 1892.

The fifth monthly meeting was held this evening, the Very Rev. Dean Carmichael, President, in the chair.

The minutes of meeting of Feby 29th were read and approved.

Minutes of council meeting of March 21st were read.

The Librarian reported the following donations to the Library:—From Sir Wm Dawson, "Notes on Parka decipens;" from American Book Company, "Laboratory Manual of Chemistry;" and usual exchanges.

Moved by the Rev. Dr. Campbell, and seconded by J. S. Shearer; that the thanks of the Society be accorded the donors of the above books.

Moved by E. T. Chambers, seconded by F. D. Adams, and resolved, that the members of the Natural History Society desire to express their sorrow at the death of Mr. F. B. Caulfield, and their sincere sympathy with his widow and family in their bereavement. They also wish to put on record their sense of the valuable services he has in so many ways rendered to the Society, especially by the valuable papers he has contributed to their publications, and the great interest taken by him in the zoological collection.

It was moved by James Gardner, seconded by F. D. Adams that the rule requiring balloting be suspended, and M. Monongahela de Beaujeu be elected an ordinary member.

Mr. F. D. Adams read an obituary notice with notes of the scientific work of Dr. T. Sterry Hunt.

Moved by Sir W. Dawson, seconded by J. S. Shearer, That the obituary of the late Dr. T. Sterry Hunt, LL.D., F.R.S., read at this meeting be published in the RECORD OF SCIENCE, as a memorial of its distinguished subject and as a testimony of their regard for him as one of the most eminent of the members and officers of this Society, and one whose labours shed so much lustre on Canadian Science.

Moved by Sir W. Dawson, seconded by the Rev. Dr. Campbell, that J. S. Shearer, J. S. Brown, James Gardner and A. F. Winn be appointed a committee to arrange for providing some help for Mr. Caulfield's family.

A paper on the European house sparrow by W. A. Oswald of Belle Riviere, Que., was read.

Proposed by Sir W. Dawson, seconded by the Rev. Dr. Campbell the thanks of the Society be given to Mr. Oswald for his paper. Carried.

MONTREAL, April 25th, 1892.

The sixth monthly meeting was held this evening, John S. Shearer, Vice-President, in the chair.

Minutes of last meeting (March 28th) were read and approved.

The Librarian reported the usual exchanges, with the Smithsonian reports and Illustrations of Grasses of North America, from the Department of Agriculture, Washington.

To the Museum, from H. J. Tiffin, a lead from a corner stone of a building bearing date 1751.

Moved by J. S. Brown, seconded by Mr. Joseph that the thanks of the Society be sent Mr. Tiffin for his valuable donation. Carried.

Moved by Mr. E. Judge, seconded by Mr. G. Sumner that the Very Rev. Dean Carmichael be appointed delegate to the meeting of the Royal Society at Ottawa May 31st. Carried.

J. S. Shearer, Dr. Stirling, and R. W. McLachlan were appointed auditors.

It was moved by J. Gardner, seconded by J. S. Brown

that the rules be suspended and the following be elected members by acclamation. Carried.

L. Huot proposed by J. S. Shearer seconded by J. Gardner and E. D. Wintle proposed by A. Inglis seconded by J. Gardner.

Moved by J. S. Brown, seconded by G. Sumner that the invitation of the Hon. J. K. Ward to hold the next field day at the Riviere Rouge be accepted. Carried.

Capt. R. C. Adams gave a paper on the "Mineral rescources of the Kootenay District" Moved by E. Judge, seconded by J. S. Brown that the thanks of the Society be accorded Capt. Adams for his valuable lecture.

MONTREAL, May 30th, 1892.

The Annual Meeting was held this evening, the Very Revd. Dean Carmichael, President, in the Chair.

The Minutes of last Annual Meeting were read and approved.

Mr. Shearer on behalf of the Field Day Committee reported that all had been arranged with the Hon. J. K. Ward and the C. P. R. for the excursion to Rivière Rouge.

Mr. Brown, Hon. Curator, reported that two cases of Birds had been donated to the Museum by Mr. H. J. Tiffin.

Proposed by Mr. Brown, seconded by Hon. Senator Murphy, that the thanks of the Society be sent to the donor.

On the suggestion of Sir W. Dawson, the delegates to the Convention of the Dominion Educational Association to be held in Montreal in July were invited to visit the Museum of the Society.

Mr. J. S. Brown suggested that the title of the Record be altered so as to read, The Canadian Record of Science, the Journal of the Natural History Society of Montreal.

Referred to the Editing Committee.

The President then delivered his annual address in which he referred to the various objects for which the Society was established.

Mr. J. S. Shearer, Chairman of Council read the report of Council.

Mr. James Gardner, Hon. Treasurer reported the total disbursements of $2248.95, and the receipts $2489.93, leaving a balance on hand of $240.98.

Mr. J. S. Brown, Hon. Curator, reported on the state of the Museum, noting a large increase in the number of visitors during the last year.

Mr. E. T. Chambers, Hon. Librarian, gave the report of Library Committee, showing a number of standard works added by purchase to the library during the year.

In the absence of Dr. T. Wesley Mills, the report of the Editing Committee was read by the Revd. Dr. Campbell.

Proposed by J. S. Shearer, seconded by the Revd. Dr. Smyth, that the reports just read be received, adopted and printed in the "Record."

Mr. Gardner and Mr. Winn were appointed scrutiners, and the election of officers was proceeded with.

Sir William Dawson was elected Hon. President on motion of Hon. Senator Murphy, seconded by Judge Wurtele.

Moved by Revd. Dr. Smyth and seconded by J. H. Joseph, that the Very Revd. Dean Carmichael be elected President.

Moved by J. H. Joseph, seconded by Hon. Senator Murphy, that Dr. T. Wesley Mills, be 1st Vice-President.

The following were on motion elected Vice-Presidents:

Vice-Presidents:—Hon. Senator Murphy, J. H. R. Molson, John S. Shearer, Sir Donald A. Smith, Rev. R. Campbell, D.D., Geo. Sumner, Rev. W. J. Smyth, B.A., B.Sc., Ph. D., J. H. Joseph, B. J. Harrington, Ph. D., F. R. S. C.

Hon. Recording Secretary:—R. W. McLachlan.

Hon. Corresponding Secretary:—John W. Stirling, M. B.

Hon. Curator:—A. F. Winn.

Hon. Treasurer:—James Gardner.

The scrutineers reported the following as elected members of Council.

Members of Council:—John S. Shearer, Chairman, Edgar Judge, Frank D. Adams, M. A. Sc., Albert Holden, Major L. A. H. Latour, M. A., Judge Wurtele, J. A. U. Beaudry, C. E., Prof. D. P. Penhallow, B. Sc., Prof. J. Cox, M. A., C. S. J. Phillips.

The following were elected on the Library Committee.

Library Committee:—E. T. Chambers, Chairman, J. A. U. Beaudry, C. E., R. W. McLachlan, Joseph Fortier, A. F. Winn, J. F. Hausen.

Editing and Exchange Committee:—Frank D. Adams, M. A. Sc., Chairman, G. F. Matthews, St. John, N. B., J. F. Whiteaves, Ottawa, Dr. B. J. Harrington, B.A., Ph. D., F. G.S., Rev. R. Campbell, D. D., Dr. T. Wesley Mills, Prof. D. P. Penhallow.

MONTREAL, May 30th, 1892.

The Meeting of the Council was held after the Annual Meeting. Present, John S. Shearer, in the Chair, Dean Carmichael, Senator Murphy, Revd. Dr. Campbell, J. H. Joseph, James Gardner, A. F. Winn, Edgar Judge, Judge Wurtele, C. S. J. Phillips and E. T. Chambers.

Mr. J. S. Shearer was elected Chairman.

The following committees were appointed :

Lecture Committee:—Dr. B. J. Harrington, Chairman, Rev. R. Campbell, D. D., Prof. John Cox. Dr. J. W. Stirling, Rev. W. J. Smyth.

House Committee:—John S. Shearer, Chairman, Edgar Judge, Jas. Gardner.

Membership Committee:—Edgar Judge, Chairman, S. Finley, G. Sumner, Rev. W. J. Smyth, P. S. Ross, J. A. U. Beaudry, R. W. McLachlan, J. S. Shearer, J. Gardner, J. F. Hausen.

Report of the Council, 1892–93.

The Session of 1891-2, which closes with this meeting, has been an interesting and eventful one to the Society. Your Council has held seven meetings, and there have been six monthly meetings of the Society, at which interesting and instructive papers have been read. Eight new members were elected during the year. As stated in my last report, the Royal Society of Canada had received and accepted the invitation of this Society to hold its meeting in Montreal on the 27th of May, 1891, the first ever held outside of Ottawa. The members assembled in large numbers from all parts of Canada, and also from the United States. The different committees appointed to carry out the programme for the meeting, and for the comfort and enjoyment of the members and invited guests, were eminently successful, and we desire to tender to them the thanks of the Society. We are likewise indebted to the Governors of McGill College for granting the use of the building for the meetings of the Royal Society. Your Society have to record the loss by death of Dr. T. Sterry Hunt, an eminent scientist and an original thinker, who held at one time the positions of President and Vice-President of the Society, and labored long and faithfully in its interests. His death is a great loss to the scientific world, and also to the Natural History Society. We have also to mourn the loss by death of another earnest worker, Mr. F. B. Caulfield, who labored constantly to promote the interests of the Society. It will be difficult to find one to replace him in his department of the Society's work.

There is every probability of the grant for the "Record of Science" being continued by the present Government. Your Chairman has been in communication with the Treasurer of the Province for some time past. The building of the Natural History Society is in good order, and the Hall has been leased for 1892-3 to the same occupants as before. I may mention here that the Hall will require to be reseated at an early date, and we commend this work to our successors in office.

The Membership Committee has not met once this season, and, in consequence, the membership of the Society has fallen off this year very much. We recommend that this Committee should meet once a month and give their attention to new members, and prevent, if possible, the withdrawing of others from the Society.

The Hon. Curator will report on the museum, which has been well patronized during the year. The library has received considerable attention and shows improvement. An effort is being made to render it more useful to the members and students, as

will be shown in the Hon. Chairman's report. The "Record of Science" has been issued regularly, full of interesting scientific matter, and the thanks of the Society are hereby tendered to the Editing Committee. The free course of Somerville lectures, six in number, were delivered during the winter, and were well received and much appreciated. The attendance was fully as large as at any previous course. The museum was open as usual an hour before each lecture. The lectures were as follows:—

Thursday, February 25th—"How to Study Botany." By Dr. T. J. W. Burgess, of the Hospital for the Insane.

Thursday, March 3rd—"Canadian Trees and their Distribution." By Prof. J. Macoun, M.A., F.L.S., F.R.S.C., of the Geological Survey, Ottawa.

Thursday, March 10th—"Fossil Sunshine." By Sir J. W. Dawson, C.M.G., LL.D., F.R.S., etc.

Thursday, March 17th—"Canadian Woods—Their Economical Use." By Hon. J. K. Ward, M.L.C.

Thursday, March 24th—"Fruits and Fruit Culture," for the Province of Quebec. By Prof. J. Craig, of the Dominion Experimental Farm, Ottawa.

Thursday, March 31st—"A Talk about the Wild Flowers around Montreal." By Robert Campbell, D.D., M.A.

Your Council recommends that the thanks of the Society be tendered and conveyed to the gentlemen who gave their valuable time and labour in the preparation and delivery of these lectures. We have to express our regret that the health of our esteemed President has been such during the past winter as to prevent his attending the meetings of the Society.

The Annual Field day took place as usual, Calumet being the place selected. The attendance was unprecedentedly large. A number of the members of the Royal Society accompanied the excursionists, as well as several of our aldermen. A more delightful spot could not have been selected, and the weather was all that could be desired. A full report of the day's outing will be found in volume four, number seven, of the "Record of Science." The Society beg to tender their thanks to the Field day Committee for their very complete arrangements. Our thanks are due to the officers of the C. P. R., for their kindness and attention; everything done by them tended to promote the success of the excursion. We have also to thank the Hon. J. K. Ward for his kind offices, and for entertaining so many of our party at his lumber establishment. The Field day to be held on the fourth of June next, on the in-

vitation of the same kind gentleman, will be at the "Rivière Rouge." As this is a delightful spot for scientific work, we would like to see our members turn out in full force. We are to have a special train from the C. P. R., on this occasion, to leave Windsor St. Depot at 9 a. m.

Respectfully submitted
JOHN S. SHEARER
Chairman.

Report of the Editing Committee of the Record of Science.

An attempt has been made to maintain throughout the year the high standard which the Record has reached as an exponent of the science of the Dominion, and it is believed that in this your committee has been successful.

It would, however, render the journal more interesting to a larger number of readers if a greater proportion of papers on biological subjects could be secured.

Though a couple of the numbers for this year were late, owing to unavoidable circumstances, the quality of the matter did not suffer, and excellent original papers have been found in all the numbers.

It is desirable to introduce more and better illustrations into the Record, and for this purpose a sum not less than $150.00 per annum should be at the disposal of the committee.

We think it would be well if some one competent and willing to devote special attention to the subject of exchanges were added to the committee.

It is but right to mention that by far the greater part of the work in connection with the Record has fallen to Mr. Frank Adams, who has devoted much time, energy and ability very cheerfully to the work. The Committee feel deeply indebted to him, and trust that he may continue to give his valuable services in this field of work.

Wesley Mills,
Chairman.

NATURAL HISTORY SOCIETY OF MONTREAL IN ACCOUNT WITH JAMES GARDNER, HON. TREASURER.

Receipts.		*Disbursements.*	
To Rents	$1,026 00	By Balance from last year due Treasurer	$ 40 99
" Members Annual Subscriptions	635 00	" Superintendent's Salary and Commissions	507 45
" Government Grant	400 00	" Sundry expenses	225 43
" Grant from Citizens Committee Royal Society meeting	300 00	" Light	285 64
" Field day surplus	48 55	" Fuel	155 04
" Interest	9 68	" Taxes	29 25
" Entrance Fees Museum	39 70	" Lectures	24 20
" Record of Science, 2 vols. sold	6 00	" Museum	140 39
" W. Badgley, per Bank of Montreal, amount deposited to the credit of the Society in 1845.	25 00	" Library	41 67
		" Record of Science	798 89
		" Balance on hand	240 98
	$2,489 93		$2,489 93
1892. May 30 To Balance on hand	$240 98		

E. & O. E.

Examined and found correct,

JOHN S. SHEARER.

MONTREAL, 30th May, 1892.

CURATOR'S REPORT.

To the President and Members of the Natural History Society :

Gentlemen :—It gives me pleasure to report that the results which it was expected would follow a better arrangement and a more comprehensive classification of the contents of the Museum have been largely realized, the cost has been comparatively small, while the increased advantages offered to the student of nature can hardly be over estimated, and fully justify the expenditure.

During the year a larger nnmber of persons have visited the Museum than for many years past. And a comparison of the last few years warrants me in saying that the new order of things is being appreciated.

For the year	ending	May	1888—451	persons	visited	the	Museum.
"	"	"	"	1889—1192	"	"	"	"
"	"	"	"	1890—2094	"	"	"	"
"	"	"	"	1892—2596	"	"	"	"

NOTE—the Museum was closed for alterations during the greater part of 1891, and therefore no record of visitors was kept.

The donations to the Museum have increased in proportion, not only in number, but also in value.

The natural products from the Island of Jamaica and St. Vincent, presented through Mr. John Fulton, have proved of considerable value to those interested in West Indian products.

The space occupied by the Museum is I regret to say altogether inadequate to the amount of material to be displayed, and we are in consequence obliged to store away a large number of interesting specimens, thus greatly detracting from the value of our collection in certain branches.

An order has been given for a new cabinet to hold the balance of the entomological collection, which Mr. Winn has kindly consented to label and classify.

Mr. Griffin as usual has aided me greatly in maintaining the Museum in its present satisfactory condition, and I refer with pleasure to the perfect harmony which has existed between the members of the Museum Committee and those who have assisted in the work of the Museum throughout the year.

I desire to record my sincere regret at the death of Mr. F. B. Caulfield, so long an active member of this Society, and in whose demise the Museum loses a warm friend and a zealous worker. For some time past Mr. Caulfield—I may say—had taken the entire charge of our ornithological collection; to his energy and ability are we indebted for its present classification and arrangement, while the splendid condition of the specimens testify to the faithfulness with which he performed this work.

In conclusion allow me to thank you for the confidence which you have shown in me during my administration. I feel that there is still much to be accomplished, indeed, there is always work in a museum for willing hands to do; other duties would prevent me giving the time which this important office requires even were you disposed to re-elect me, and in assigning to others the work which for the past four years has given me so much pleasure, I desire to assure you of my continued interest in the progress of the museum, and that I will gladly assist in any measures calculated to increase its usefulness.

Respectfully submitted
J. STEVENSON BROWN.
Hon. Curator.

MONTREAL
May 30th, 1892.

DONATIONS TO MUSEUM.

Brown Thrasher,—*Harporhynchus Rufus.*
Red Shouldered Hawk,—*Buteo Lineatus.* (nestling)
Wood Thrush,—*Turdus Mustelinus.*
Yellow Legs,—*Totanus Flavipes.*
Golden Pheasant,
Nest of Long Billed Marsh wren,—*Cistothorus Palustris.*
Swallow's Nests.
Two large cases of Birds (various)
Wood Chuck,—*Arctomys Monax,* (Black Variety)
Land Crab,—*Gecarcinus Lateralis.*
Rattle Snake skin, with rattle attached.
Bivalve,—*Ambronychia Radiata* from Hudson River group.
Collection of Insects. (various)
Collection of Natural Products from Jamaica and St. Vincent.
Leaden Plate, with inscription, found in 1867 while demolishing a building owned by the late Joseph Tiffin senior, situated opposite Bonsecours Market. The building is supposed to have belonged to the French Government, and this plate is regarded as a relic of the former rule *of France in this Country.*

By Purchase

Greebe

J. STEVENSON BROWN,
Hon. Curator.

Report of the Library Committee.

The following books and pamphlets have been received during the past year in addition to the exchanges.

Dana's Manual of Mineralogy from Mr. H. Martin.

Laboratory Manual of Chemistry from American Book Company.

Illustrations of North American Grasses, from Department of Agriculture, Washington.

Transactions of the American Institute of Mining Engineers.

Report of Geological Survey of Canada.

Report of U. S. Geological Survey.

Monographs of U. S. Geological Survey.

Geology of Illinois, 2 vols.

The following were presented by the Authors :—

Systematic Mineralogy, by Dr. Sterry Hunt.

Our Trees, by J. Robinson of the Essex Institute.

Old Memories, by Mrs. Macpherson.

Notes on Parka decipiens, by Sir J. W. Dawson.

Select extra-tropical plants eligible for naturalization, by Baron Von Mueller, Victoria, Australia.

Polyzoa of the St. Lawrence, by Rev. T. Hincks.

Mollusca, collected in Japan, By F. Stearns.

Catalogue of British fossil Vertebrata, by Woodward & Sherborn.

The Society has been enabled by the purchase of twelve of the earlier volumes of the German Geological Survey to make up what is believed to be the only complete set in Canada of that useful geological work.

At the request of your Committee the Council have appropriated the sum of $100 for the purchase of Standard works on the different departments of Natural History, books which are so often enquired for by the members. The following have already been received from the booksellers :—

French's Butterflies of the United States.

Say's Entomology of North America, 2 vols.

Coue's Key to North American Birds.

Ridgway's Manual of North American Birds.

Micrographic Dictionary.

Scientific Papers of Asa Gray, 2 vols.

Treasury of Botany, 2 vols.

Text Book of Mineralogy, Dana.

Compendium of Geology, Le Conte.

Handbook of Canadian Geology, Sir J. W. Dawson.
The Earth and Man, Guyot.
Characteristics of Volcanoes, Dana.
The Human Species, Quatrefages.
The Primitive Condition of Man, Sir Jno. Lubbock.
Fossil Men, Sir J. W. Dawson.

Nearly one hundred volumes of exchanges have been prepared for binding, and as soon as the works in the French language have been selected and arranged, will be placed in the binder's hands as directed by the Council.

It has been thought fit for the information of members to present with this report a list, as complete as possible, of the publications now received in exchange for the Record of Science.[1] In looking through this list it is seen that it requires revision, and on comparing it with the lists of other similar institutions, it is evident that it might be much extended. It is therefore suggested that the exchange committee might be asked to take this matter in hand.

The Hon. Librarian in concluding his report cannot but express his sense of the loss sustained by the death of the late Mr. F. B. Caulfield, who was for so many years a member of this Committee. He was for some time Librarian, and as he always took great interest in examining new books as they were added, was so well acquainted with the contents of the cases, that his knowledge and advice were at all times of the greatest assistance.

Respectfully submitted,

E. T. Chambers.

Annual Field Day.

The students of the different branches of natural history, organized under the name of the Natural History Society, have a good field for the pursuit of their specialties on Montreal Island, but with the view of extending the field of research, the annual outing of the society is an established institution. This year, as last, their destination was the River Rouge, near Calumet, to which they flocked in large numbers on Saturday, June 4th.

A special train under the courteous and efficient charge of Abe E. Wright, left the Windsor Depot at 9 o'clock.

Three handsome Canadian Pacific Railway cars were comfortably filled with the party, which was under the guidance of Mr. J. Stevenson Brown and Mr. J. S. Shearer, who acted as an arrangements committee, so to speak. The Rouge was reached about 12 o'clock, and family parties were soon discussing cold collations beneath the shade of forest pines and oaks. A large number of others accepted the invitation of Hon. J. K. Ward to partake of pot luck in the lumber camp. The dining room was a typical lumbering shanty and the bill of fare consisted of pea soup, made over a camp fire outside, pork and beans with potatoes, white bread and dried apple sauce, or molasses and tea *a la Russe*, but without the lemons. The plate was of tin and the service given by "Chef" Jean Baptiste Cadieux and his assistants excellent. Epicures who dine off turtle soup, oysters, etc., cannot appreciate the merits of pea soup when seasoned with the appetites a scientific exploring party possessed. The dinner was a novelty and a success.

The different sections set out immediately after dinner and their expeditions proved most successful.

The tumultuous cascades of the Rouge down which the logs were precipitated, was a constant source of enjoyment to many, and those who labored higher up the stream to the immense "chutes" 60 feet in height, were amply rewarded. The timbers dived madly down them and on striking the river were immersed for a distance of at least one-twelfth of a mile. Large square timbers 30 feet in length were broken like pipe-stems on becoming crossed at the foot of the chute. These sights alone were worth going to see, and sketchers certainly did not lack for interesting subjects.

"Old Probs" also was kind to the party. He hung out portents of rain at one o'clock, but kindly deferred the execution of his threats till all were safely returning home. The cloudiness only rendered the day cooler and more enjoyable.

The courtesies extended by the Canadian Pacific Railway

authorities to the excursionists were much appreciated. On the return journey tea, coffee and sandwiches were handed round on the cars by assiduous waiters, and this course was followed by strawberries and cream *ad lib.* In return, when the depot was reached, the party assembled and heartily carried a vote of thanks to the company, proposed by Mr. J. S. Shearer. Neither did the Hon. J. K. Ward's hospitality go unrecognized, for before leaving camp, Mr. Henry Lyman and Mr. J. H. R. Molson, in brief speeches, expressed the gratitude of all for his kindness and courtesy. Mr. Ward made a suitable reply in which he invited the society to visit the Rouge again whenever they wished.

The results of the competitions were as follows :—

GEOLOGICAL SPECIMENS.

[1] J. C. Saxe, 16 named.
[1] R. B. Van Horne, 15 unnamed.

BOTANICAL SPECIMENS.

[1] Miss A. Van Horne, 50 named.
[1] Miss Jessie Brown, 51 unnamed.
[1] Prize sketch, Miss Foudrinier.

The leaders, and in such case the judges, of the different sections were: Botany, Messrs. J. B. Goode and James Gardner; geology, Messrs. W. E. Deeks and Evans; entomology, Mr. A. F. Winn, and sketching, Mr. Henry Carter. In the sketching class several excellent oil and water color paintings were submitted for competition, but the prize fell to Miss Foudrinier for a pleasing and careful oil sketch of the Ottawa River as seen from the mouth of the Rouge. In the entomological section several good collections were made, but there was no competition as the collections are mostly professional.

Among those present were noticed :—Mr. and Mrs. Robt. Miller, Mr. and Mrs. J. W. Mills, Mr. and Mrs. J. H. R. Molson, Hon J. K. Ward, Mrs. Ward and Miss M. Ward ; Dr. Burgess, Superintendent of Verdun Hospital for the Insane; Mr. and Mrs. J. S. Shearer, Mr. and Mrs. J. Steven-

son Brown and family; Mr. E. T. Chambers, of the British Canadian School; Messrs. A. W. Smith, A. Falconer, S. Carmichael, R. B Van Horne, Alfred Winn, C. B. Chisholm, and Alfred Griffin; Mr. Henry Lyman and Miss Lyman; Miss and Mrs. A. Van Horne, Miss Boissvaian, Miss Turner, Miss Burland, Miss Reid, Miss Jessie Brown, Miss Smith and Miss Rankin, Mr. and Mrs Albert Holden and family, Mr. and Mrs. James Gardner, Mr. and Mrs. Thos. E. Hodgson, Mr. and Mrs. R. W. McLachlan, Captain R. C. and Mrs. Adams, Mr. John Fair and Mr. Harry McLaren, Mr. and Mrs. Walter Drake, Professor Fowler, ex-Ald. Shorey, Mrs. Stephenson, Mr. and Mrs. Charles Garth, Mrs. Hollis, Mrs. Elliott, Mrs. Campbell, Mrs. Pennell, Mrs. and Miss Bulmer, Mrs. and Miss Verner, Mr. J. F. Hausen, Mr. Walter Le Rossignol, and Mr. and Mrs. Fredericks.

Notices of Books and Papers.

Lessons in Botany.[2] Part II, Flowers and Fruit, of Miss Newell's book, is before us. As indicated by the title page, it is intended "for the use of teachers, or mothers studying with their children." The object in view has been very successfully attained, and the book cannot fail to be useful to those for whom it is written. The style is simple and pleasing, and the facts are presented in a way to make them readily understood. One very commendable feature of the book, but one not usually made use of, is the relegation of the figures to separate plates closely associated with the corresponding text. Descriptions of the various species treated of will serve an important purpose in guiding the teacher to proper methods of treatment in the analysis of flowers. A simple but serviceable glossary completes the volume, which the publishers have put into a very readable form.

[1] It is intended to publish a revised list in a future number.

[2] Outlines of Lessons in Botany, for the Use of Teachers, or Mothers Studying with their Children, by Jane H. Newell. Part II: Flowers and Fruit. Illustrated by H. P. Symmes, Boston: Ginn & Heath. 8vo., pp. 393. 1892.

ARCH, 1892.

vel, 187 feet. C. H. McLEOD, *Superintendent.*

Sky Clouded in Tenths. Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
5.0	10	0	85	....	0.1	0.01	1
5.5	10	0	81	....	....	....	2
4.0	10	0	88	....	....	....	3
4.5	10	0	27	....	....	....	4
2.3	6	0	84	....	....	....	5
....	..	..	0	....	....	....	6 .... SUNDAY
5.2	10	0	59	...	....	....	7
8.3	10	0	0	Inap.	1.2	0.19	8
10.0	10	10	0	Inap.	1.3	0.13	9
8.3	10	0	0	0.03	1.5	0.18	10
10.0	10	10	0	Inap.	15.9	1.59	11
6.3	10	0	26	.. .	....	....	12
....	..	..	96	....	....	....	13 ....SUNDAY
8.3	10	0	34	....	....	....	14
7.0	10	0	72	....	....	.	15
1.0	5	0	74	....	....	....	16
7.3	10	0	42	....	....	....	17
8 0	10	0	0	....	0.6	0.06	18
8.3	10	0	0	....	5.3	0.41	19
....	..	..	0	....	1.2	0.12	20 .... SUNDAY
0.5	3	0	95	....	...	...	21
5.3	10	0	53	....	Inap.	Inap	22
10.0	10	10	0	0.26	7.5	1.15	23
4 8	10	0	73	....	....	....	24
8.3	10	0	0	....	....	....	25
0.0	0	0	96	....	....	....	26
....	..		95	....	....	....	27 ....SUNDAY
6.5	10	0	76	....	....	....	28
0.8	5	0	96	....	....	....	29
0.2	1	0	96	....	....	....	30
0.5	3	0	95	....	....	...	31
5.3	....	....	50	0.29	34.6	3.84	Sums ....
6.1	....	....	¶46.8	0.93	25.6	3.46	18 Years means for and including this month.

sea-level and

mercury.

eing 100.

the 28th and

ow zero on the

re of 41.3 de-

Coldest day

was the 13th. Highest barometer reading was 30.526 on the 2nd; lowest barometer was 29.035 on the 11th, giving a range of 1.491 inches. Maximum relative humidity was 98 on the 8th. Minimum relative humidity was 42 on the 28th.

Rain fell on 5 days.

Snow fell on 10 days.

Rain or Snow fell on 10 days.

Auroras were observed on 10 nights.

PRIL, 1892.

vel, 187 feet. C. H. McLEOD, *Superintendent.*

Sky Clouded in Tenths. Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	Day.
3.2	10	0	92	....	....	....	1
5.0	10	0	41	0.10	....	0.10	2
6.5	10	0	91	....	....	....	3 .. .. SUNDAY
9.2	10	5	0	0.07	....	0.07	4
4.5	10	0	0	0.33	...	0.33	5
4.2	10	0	83	....	Inap	Inap.	6
8.2	10	5	92	....	....	....	7
10.0	10	10	25	0.12	....	0.12	8
...	..	..	0	0.03	3.6	0.39	9
9.8	10	9	18	....	3.2	0.32	10 ....SUNDAY
6.5	10	0	34	...	0.1	0.01	11
5.0	10	0	0	...	0.3	0.03	12
2.3	10	0	91	....	....	....	13
2.2	6	0	97	....	....	....	14
10.0	10	10	93	....	....	.	15
....	..	..	18	....	....	....	16
6.2	10	0	25	....	....	....	17 ..... SUNDAY
2.0	7	0	38	....	....	....	18
0.3	2	0	98	....	....	....	19
6.7	10	0	99	....	....	....	20
9.2	10	5	51	0.07	...	0.07	21
7.8	10	1	35	0.05	....	0.05	22
....	..	..	48	0.02	....	0.02	23
0.0	0	0	91	....	....	....	24 ....SUNDAY
0.0	0	0	98	...	....	....	25
4.2	10	0	97	....	....	....	26
8.3	10	0	76	....	....	...	27
8.0	10	3	0	0.22	...	0.22	28
3.2	10	0	0	....	....	....	29
....	..	.	80	....	....	....	30
5.5	....	....	54	1.01	7.2	1.73	Sums ....
5.9	....	....	¶52.2	1.61	6.6	2.27	18 Years means for and including this month.

sea-level and

mercury.

being 100.

the 22nd; the giving a range Warmest day 12th. Highest he 27th; lowest

barometer was 29.453 on the 9th, giving a range of 1.059 inches. Maximum relative humidity was 96 on the 5th. Minimum relative humidity was 16 on the 20th.

Rain fell on 9 days.

Snow fell on 5 days.

Rain or Snow fell on 13 days.

Auroras were observed on 7 nights.

Lunar halos on 3 nights.

Fogs on 2 days.

Thunderstorm on the 5th.

F MAY, 1892.

e sea level, 187 feet. C. H. McLEOD, *Superintendent.*

ND.	Sky Clouded In Tenths.			Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
Mean velocity in miles perhour	Mean.	Max.	Min.					
9.2		..		00	Inap.	....	0.00	1 .... Sunday
10·4	7.5	10	1	00	Inap.	....	0.00	2
16.6	10.0	10	10	15	Inap.	....	0.00	3
29.8	3.7	10	0	68	0.05	....	0.05	4
16.7	2.8	10	0	76	....	....	. ..	5
11 0	3.3	10	0	43	...	....	....	6
18.6	8.3	10	0	22	....	....	....	7
15.1	....	..	..	84	....	....	....	8 ....Sunday
18.7	2.0	10	0	98	....	....	...	9
9.5	1.2	5	0	87	....	....	....	10
12.6	10.0	10	10	00	0.39	....	0.39	11
15.7	8 8	10	3	00	0.16	....	0.16	12
7.5	2.5	10	0	92	....	....	..	13
10.8	1.8	3	0	92	....	....	....	14
14.7	....	..	..	00	....	....	....	15 .... .Sunday
26 2	7.3	10	0	35	0.05	....	0.05	16
25.0	1 7	10	0	73	...	....	....	17
15.9	0 0	0	0	58	....	....	....	18
14 7	0.5	3	0	96	....	....	....	19
11.1	8 3	10	0	05	....	....	....	20
13 8	10.0	10	10	00	0.28	....	0.28	21
18.9	....	..	..	00	0.05	....	0.05	22 ....Sunday
17.6	9 8	10	9	00	0.44	....	0.44	23
20.6	10.0	10	10	49	0.05	....	0.05	24
20.2	9.3	10	6	37	. .	....	....	25
11.9	8 2	10	5	63	Inap.	....	0 00	26
15 3	10 0	10	10	00	0 62	....	0 62	27
15.2	2.8	10	0	91	0.05	....	0.05	28
16.0	....	..	..	39	0.06	....	0.06	29 ....Sunday
10.0	6.7	10	0	50	....	....	....	30
5.1	6.2	10	0	57	....	....	....	31
15.3	5.87	....	....	43	2.20	....	2.20	Sums ... .
...	6.3	....	....	¶50.9	2.87	....	2.87	18 Years means for and including this month.

educed to sea-level and
nheit.

inches of mercury.

uration being 100.

s 81.2 on the 31st; the he 1st and 6th, giving a 47.2 degrees. Warmest ay was the 23rd. Highest).365 on the 9th; lowest barometer was 29.435 on the 27th, giving a range of 0.930 inches. Maximum relative humidity was 96 on five days. Minimum relative humidity was 20 on the 18th.

Rain fell on 15 days.

Auroras were observed on 4 nights, the most brilliant display being on the night of the 18th.

Lunar halos on 2 nights.

Fog on the night of the 30th and morning of the 31st.

Solar halo with parhelic arcs on the 10th.

JUNE, 1892.

el, 187 feet. C. H. McLEOD, *Superintendent.*

Sky Clouded in Tenths. Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
5.0	9	0	91	....	....	. ..	1
9.3	10	7	19	0.35	....	0.35	2
7.3	10	0	73	....	....		3
8.2	10.	0	36	0.03	....	0.03	4
....	..	0	00	1.35	....	1.35	5 .... SUNDAY
6.2	10	0	73	0.09	....	0.09	6
0 0	0	0	98	.	...	....	7
8 3	10	0	04	0.15	....	0.15	8
7.7	10	0	30	0 17	....	0.17	9
1.5	5	0	88	....	....		10
4.7	10	0	56	....	....	....	11
....	..	.	60	0.06	...	0.06	12 .... SUNDAY
6.0	10	0	81	....	.	....	13
6.2	10	0	50	0.06	....	0.06	14
0.7	2	0	97	....	....	....	15
5.2	10	0	42	0.10		0 10	16
5.8	10	0	37	0.08	....	0.08	17
8.3	10	0	44	....	....	.	18
....	..	..	00	0.94	....	0.94	19 .... SUNDAY
8.5	10	1	00	2.14	....	2.14	20
6.0	10	0	60	0.02	....	0 02	21
6.8	10	0	58	0.01	....	0.01	22
6.7	10	0	14	0.06	....	0.06	23
6.0	10	0	80	0 21	....	0 21	24
7.7	10	0	15	0.44	....	0.44	25
	..	0	07	0.34	....	0.34	26 .... ..SUNDAY
8.0	10	0	21	0.61	....	0 61	27
7.5	10	4	32	0.08	....	0.08	28
4.5	10	0	66	0.26	....	0 26	29
7.7	10	2	00	0.45	....	0.45	30
6.1	...	....	44	8.00	...	8.00	Sums ....
5.7	....	....	¶54.5	3.35	....	3 35	18 Years means for and including this month.

sea-level and

mercury.

being 100.

the 1st; the
10th, giving a
ees. Warmest
he 7th. Highest

barometer reading was 30.354 on the 4th; lowest barometer was 29.486 on the 28th, giving a range of 0.868 inches. Maximum relative humidity was 97 on four days. Minimum relative humidity was 34 on the 10th.

Rain fell on 22 days.

Aurora was observed on 1 night.

Fog on 3 days.

Thunderstorms on 9 days.

Published quarterly; Price $3.00 the Volume of eight numbers.

VOLUME V. NUMBER 4.

THE CANADIAN RECORD OF SCIENCE

INCLUDING THE PROCEEDINGS OF
THE NATURAL HISTORY SOCIETY OF MONTREAL,
AND REPLACING

THE CANADIAN NATURALIST.

CONTENTS.

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1892.

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[*Incorporated* 1832.]

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THE

CANADIAN RECORD

OF SCIENCE.

VOL. V. OCTOBER, 1892. NO. 4.

Description of a New Genus and Species of Phyllocarid Crustacea from the Middle Cambrian of Mount Stephen, B.C.[1]

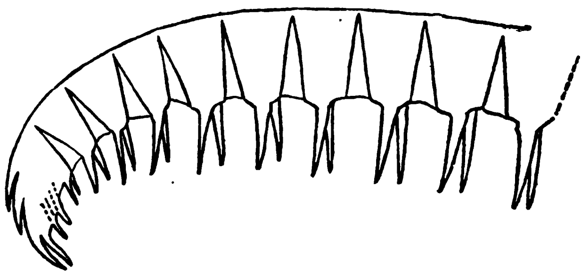
By J. F. Whiteaves.

Anomalocaris. (Gen. nov.)

Carapace and its appendages unknown or too obscurely indicated for their characters to be defined: body many jointed and consisting of not less than nine to thirteen segments, exclusive of the caudal segment; ventral portion of each of the body segments bearing a pair of slender, narrowly elongated and acutely pointed, simple and probably branchial appendages, of the nature of uropods or foot gills: posterior terminal segment margined with three pairs of caudal spines, one terminal and the other two lateral,—the posterior pair of uropods represented in the wood-cut apparently belonging to a pre-caudal segment whose posterior boundary has been obliterated.

[1] Communicated by permission of the Director of the Geological Survey of Canada.

ANOMALOCARIS CANADENSIS, sp. nov.



Anomalocaris Canadensis.—Outline of a specimen in which nine of the abdominal segments are preserved, besides the caudal segment. Natural size.

Body, inclusive of the tail, elongated, slender, decreasing slowly in size from the anterior to the posterior end, rather strongly curved posteriorly and nearly straight anteriorly, the length of the portion preserved varying in different specimens from nine to ten centimetres (as measured at about the midheight and following the curve of each), and the height or depth at the imperfect anterior end, from twelve to seventeen millimetres, exclusive of the ventral appendages. Body or abdominal segments, which, in all the specimens collected, are abnormally flattened laterally, a little higher or deeper than long, broader above than below, the pair of ventral appendages proceeding from each, nearly equal in height or depth to the segment itself. These appendages are straight and prolonged downward at almost a right angle to the main axis of the body, for although there is a slight divergence in each pair, neither are directed distinctly backward nor forward. Between each pair of segments there is evidence of a wedge-shaped or very narrowly triangular lateral area or interval, which is broadest or widest below and does not seem to extend quite to the dorsal margin. At the posterior end the segmentation is very obscurely defined. Caudal spines, which are

simple, slender, longitudinally elongated and acutely pointed, averaging six millimetres in length by about one mm. in breadth at the base: the three pairs of spines about equal in length, though the two lateral ones are placed farther forward than the central and terminal pair. Surface markings entirely unknown.

This genus and species are based upon upwards of fifty specimens collected from a band of shale of Middle Cambrian age, at Mount Stephen, near Field station on the Canadian Pacific Railway. Two of these specimens were collected by Mr. R. G. McConnell, of the Geological Survey of Canada, in 1888, and the remainder by Dr. H. M. Ami, of the same Survey, in 1891. The species seem to have been somewhat gregarious in its habits when living, for upwards of twenty specimens of it are exposed on the surface of a large slab of shale collected by Dr. Ami at this locality, and fourteen upon that of another. It is associated with numerous species of trilobites, brachiopoda, etc., most of which have been described by Dr. Carl Rominger and Mr. C. D. Walcott. All the specimens of *A. Canadensis* are crushed quite flat laterally and occur as obscurely defined and extremely thin impressions of the body segments, with the tail, the latter usually a little twisted, on each of the surfaces exposed by splitting pieces of the shale.

The generic name *Anomalocaris* (from ἀνόμοιος, unlike,—καρις, a shrimp, *i.e.*, unlike *other* shrimps) is suggested by the unusual shape of the uropods or ventral appendages of the body segments and the relative position of the caudal spines.

Only three genera of Phyllocarida have previously been recorded as occurring in the Cambrian rocks of Europe or America. These are *Ceratiocaris*, McCoy (1848); *Hymenocaris*, Salter (1853); and *Protocaris*, Walcott (1884). To these may now be added *Anomalocaris*, which differs from the other three genera of Cambrian Phyllocarids in the following particulars. In *Ceratiocaris* the caudal appendages consist of a median telson or style, and two lateral stylets. Further, although ventral appendages to the body segments

have been discovered in one species of *Ceratiocaris*, the *C. stygia* of Salter, yet these are represented as "broad and paddle shaped," not slender and acutely pointed as in *Anomalocaris*. In *Hymenocaris*, according to Prof. H. A. Nicholson, the "hinder termination of the body is adorned with three pairs of unequal spines," but in the woodcut of the type and only known species of that genus, the *H. vermicauda*, which is reproduced in so many palæontological manuals, all of these spines are represented as terminal, and the body segments as devoid of any ventral appendages. The first specimens of *Hymenocaris*, by the way, were collected by Dr. Selwyn in 1846, in the Lingula Flags near Dolgelly, Merionethshire.[1] The *Protocaris Marshii* of Walcott, from the Middle Cambrian of Vermont, is described as having no fewer than thirty narrow segments "between the posterior edge of the carapace and the telson," and a telson "which supports two caudal spines."

The wood-cut of *Anomalocaris*, is a copy of an original drawing kindly made for the writer by Mr. L. M. Lambe, F. G. S., the Artist to the Geological Survey of Canada.

OTTAWA, July 30th, 1892.

THE FLORA OF MONTREAL ISLAND.

By ROBERT CAMPBELL, D.D., M.A.

For some years I have felt, in common with others interested in our local Natural History, that it is a pity we have not a complete list of the plants growing on our own island, and when giving a paper in March, 1891, on the Summer Wild Flowers of Great Britain, I volunteered to do what I could personally to repair the want, an undertaking which the Natural History Society was pleased to approve.

[1] See Proc. Brit. Assoc. 1852, p. 58.

Throughout the season of 1891, I kept my eyes open where ever I chanced to be on the island, in the prosecution of duty or in pursuit of recreation, and I succeeded in securing specimens of the following plants, which I have mounted and presented to the museum of the Natural History Society. After I had entered on my voluntary task, the Botanical Club of Canada was formed, during the sitting of the Royal Society in this city in 1891, and it has mapped out the Dominion for Botanical purposes, assigning each county or group of counties to certain well known naturalists who are asked to take the oversight of the botanical research in their respective districts, securing the co-operation of local workers in this department, cheering them on and directing their enthusiasm. Anything I can do in connection with this joint movement, I shall be glad to attempt, and if the results I reach can be utilized by the Botanical Club, I put them entirely at its disposal. On the other hand, as one person cannot be expected to fall upon everything that grows on the island, I crave the help of every botanist in the district in the effort to secure as complete a catalogue as possible of our local flora. A well assorted cabinet of the plants growing around the city, placed in the museum of the Natural History Society, and thus put within reach of all among our citizens that are interested in this delightful science, would be a great boon; and the wonder is that an attempt to secure it has not been long ago made.

I am not overlooking the Holmes' collection, nor am I unmindful of its great scientific value. But it should not be forgotten that seventy years have elapsed since it was made, and very great and important changes must have come over the flora of the district in the interval. Besides, Dr. Holmes' Herbarium did not profess to be solely a Montreal island collection, much less did it claim to present a complete catalogue of the plant-life of the island. The bulk of the specimens which he preserved for the instruction of later generations, as might be expected, were indeed gathered in the neighborhood of the city, picked up, many

of them, doubtless, while he was prosecuting his professional work. To this extent, it may be taken as a complete Montreal collection, that it represents the island plants which came under Dr. Holmes' notice, or of which he became possessed. Other places are credited occasionally as the *habitat* of the specimens embraced, but whenever a plant was found in or near the city, Montreal was invariably first mentioned among the localities in which it grew. When Montreal is not credited with a plant, it may therefore be taken for granted that Dr. Holmes never came across the plant on the island. It will be interesting to note how far the flora of Montreal to-day corresponds with that of seventy years ago; and I have compared the collection I have so far made with the Herbarium of Dr. Holmes, with the object of finding out what changes, if any, have come about. Or rather I have taken the catalogue of the Herbarium, prepared by the late Prof. James Barnston, and published in "The Canadian Naturalist and Geologist," for April, 1859, as the basis of comparison; and I shall assume that Prof. Barnston's nomenclature is correct and in agreement with the classification of Gray, as it claimed to be.

Clematis Virginiana, L.—Common Virgin's Bower.—August. Mountain Park, south of Park Ranger's house. (Holmes).

Clematis verticillaris, DC.—Virgin's Bower—Mountain above Ravenscrag and elsewhere. (Holmes' Atragene Americana). June.

Anemone Virginiana, Gray.—Virginian Anemone.—North end of mountain, and common on the island. June.

Anemone Pennsylvanica, L.—Pennsylvanian Anemone.—(Holmes). June. Common.

Hepatica acutiloba, DC.—Sharplobed Hepatica.—North end of Mount Royal. April and May.

Hepatica triloba, Chaix.—Round-lobed Hepatica.—South end of Mount Royal, and Petite Cote Woods. (Holmes)—April and May.

Thalictrum dioicum, L.—Early Meadow-rue.—Common. (Holmes). April and May.

Thalictrum polygamum, Muhl., (T. Cornuti, Holmes).—Fall Meadow-rue.—Common. July and August.

Ranunculus abortivus, L.—Small-flowered Crowfoot. — Everywhere. (Holmes). April and May.

Ranunculus sceleratus, L.—Cursed Crowfoot.—Wet meadow at Hochelaga. June.

Ranunculus repens, L.—Creeping Crowfoot. — Common. July and August. (Holmes).

Ranunculus acris, L.—Tall Crowfoot or Buttercup.—June, September. Common. (Holmes).

Ranunuculus fascicularis.—Early Crowfoot.—Hochelaga bank. May.

Ranunculus septentrionalis, Poir.—Northern Crowfoot.—Prince Arthur street. May.

Caltha palustris, L.—Marsh Marigold.—May. Meadows, St. Cunegonde and Lachine. (Holmes).

Coptis trifolia, Salisb.—Three-leaved Gold Thread.—May, Mount Royal and Hochelaga banks. (Holmes).

Aquilegia Canadensis, L.—Wild Columbine.—West side Mt. Royal, common. May and June. (Holmes).

Aquilegia vulgaris.—Common Garden Columbine.—Escaped from cultivation, St. Laurent road. May and June.

Actæa spicata, L., var. *rubra*. Michx.—Red Baneberry.—Common. May. (Holmes).

Actæa alba, Bigel.—White Baneberry.—Common. May. (Holmes).

Caulophyllum thalictroides, Michx.—Blue Cohosh.—North end of mountain and elsewhere. May.

Nuphar advena, Ait.—Common Yellow Pond Lily.—River St. Pierre. July. (Holmes).

Chelidonium majus, L.—Celandine.—Fletcher's Field, common. (Holmes). May.

Sanguinaria Canadensis.—Bloodroot.—Common. April. (Holmes).

Dicentra cucullaria.—Dutchman's Breeches.—Petite Cote woods. (Holmes' corydalis cucullaria). May.

Corydalis glauca.—Pale Corydalis. — (Holmes). June. Mountain.

Nasturtium officinale, R.Br.—Water Cress.—Below bridge, near junction of cemeteries. July.

Nasturtium palustre, DC. — Marsh Cress. — (Holmes' sisymbrium palustre). June. Common.

Nasturtium armorica, Fries.—Horse Radish.—Creek near Cote des Neiges. June.

Dentaria diphylla, L.—Two-leaved Toothwort.—Mountain, common. May and June. (Holmes).

Arabis lævigata, DC.—Smooth Rock Cress.—Mountain, near Park Ranger's house. June. (Holmes' turritis lævigata).

Erysimum cheiranthoides, L.—Wormseed Mustard.—Fletcher's Field. June.

Sisymbrium officinale, Scop.—Hedge Mustard.—Common. June.

Brassica sinapistrum, Bois.—Charlock.—Common. June.

Brassica alba, L.—White Mustard.—(Holmes' sinapis alba). Common. June.

Brassica nigra, L.—Black Mustard.—(Holmes' sinapis nigra). Common. June.

Draba arabisans, Michx.—Whitlow Grass.—Outremont. June.

Capsella bursa-pastoris, Mœnch.—Shepherd's Purse—Common. May. (Holmes' thlaspe bursa-pastoris).

Thlaspi arvense, L.—Field Penny Cress.—(Holmes). Common. July.

Lepidium virginicum, L.—Wild Pepper Grass.—Common on streets. August. (Holmes).

Lepidium campestre, L.—Peppergrass.—Cote St. Louis. August.

Viola blanda, Willd.—Sweet White Violet.—Common. May. (Holmes).

Viola cucullata, Ait.—Common Blue Violet.—Common. May. (Holmes).

Viola pubescens, Ait.—Downy Yellow Violet.—Common. May. (Holmes).

Viola Canadensis, L.—Canada Violet.—Common. May. (Holmes).

Viola canina, L., var. *Sylvestris*, Regel.—Dog Violet.—Hochelaga banks. May.

Helianthemum Canadense, Michx.—Frost Weed.—Petite Cote. June.

Hypericum perforatum, L.—Common St. John's Wort.—Common. July. (Holmes).

Hypericum mutilum, L.—Small St. John's Wort.—Hochelaga banks. July. (Holmes' hypericum parviflorum).

Hypericum corymbosum, Muhl.—Corymbed St. John's Wort.—Cote St. Paul. August.

Elodes virginica, Nutt.—Marsh St. John's Wort.—Bout de L'isle. August.

Saponaria officinalis, L.—Bouncing Bet.—Park Avenue. August.

Silene cucubalus, Wibel.—Bladder Campion.—Common. July.

Silene Pennsylvanica, Michx.—Wild Pink.—Field near Hochelaga bank. September.

Silene noctiflora, L.—Night Flowering Catchfly.—Fletcher's Field. July.

Lychnis githago, Lam.—Corn Cockle.—Common. July.

Stellaria media, Smith.—Common Chickweed.—Common. July. (Holmes' alsine media).

Stellaria longifolia, Muhl.—Longleaved Stitchwort.—June. Cote St. Antoine. (Holmes' stellaria graminea).

Cerastium viscosum, L.—Larger Mouse-ear Chickweed.—June. Common. (Holmes).

Cerastium arvense, L.—Field Chickweed.—July. Common.

Cerastium nutans, Raf.—Nodding Chickweed.—Petite Cote. August.

Portulaca oleracea, L.—Common Purslane. —'August. Common. (Holmes).

Claytonia Caroliniana, Michx.— Spring Beauty.—May. Common. (Holmes' C. Virginica).

Malva rotundifolia, L.—Round Leaved Mallow.—June. Common. (Holmes).

Tilia Americana, L.—Basswood.—May. Common.

Linum usitatissimum, L.—Common Flax.—Cote St. Louis and elsewhere. Strayed from cultivation. August.

Oxalis acetosella, L.—White Woodsorrel.—July. Hochelaga woods. (Holmes).

Oxalis stricta, L.—Yellow Woodsorrel.—June. Common. (Holmes' O. Dillenii).

Impatiens fulva, Nutt.—Spotted Touch-me-not.—July. Common. (Holmes I. noli-me-tangere).

Impatiens pallida, Nutt.—Pale Touch-me-not.—August. Common. (Holmes I. biflora).

Zanthoxylum Americanum, Mill.—Northern Prickly Ash.—April. Field near Petite Cote. (Holmes' Z. fraxineum).

Rhus typhina, L.—Staghorn Sumach.—Mt. Royal. July. (Holmes).

Rhus toxicodendron, L.—Poison Ivy.—June. Common. (Holmes).

Vitis cordifolia, Michx.—Frost Grape.—June. Common. (Holmes' V. riparia).

Ampelopsis quinquefolia, Michx.—Virginia Creeper.—Mountain and along fences on island. July. (Holmes' cissus hederacea).

Celastrus scandens, L.—Climbing Bitter-sweet.—June. Common on fences over the island. (Holmes).

Acer Pennsylvanicum, L.—Striped Maple.—May. North end of mountain.

Acer spicatum, Lam.—Mountain Maple.—May. Common. (Holmes).

Acer saccharinum, Wang.—Sugar Maple.—May. Lachine and elsewhere on island. (Holmes).

Acer dasycarpum, Ehrhart.—Silver Maple.—April. Common.

Acer rubrum, L.—Red Maple.—May. Common. (Holmes).

Trifolium pratense, L.—Red Clover.—June. Common. (Holmes).

Trifolium repens, L.—White Clover.—June. Common. (Holmes).

Trifolium agrarium, L.—Hop Clover.—June. Hochelaga bank.

Trifolium procumbens, L.—Low Hop Clover. — July. Hochelaga bank.

Medicago lupulina, L.—Black Medick.—June. Everywhere.

Melilotus officinalis, Willd.—Yellow Sweet Clover.—June. Everywhere.

Melilotus alba, Lam.—White Sweet Clover.—June. Common.

Robinia pseudacacia, L.—Common Locust.—June. St. Michel.

Desmodium acuminatum, DC.—Tick Trefoil.—August. Mountain. (Holmes' Hedysarum acuminatum).

Desmodium Dillenii, Darling.—Tick Trefoil.—August. Northern part of Mountain.

Desmodium Canadense, DC.—Tick Trefoil.—August. Park near north end of mountain. (Holmes' Hedysarum Canadense).

Vicia sativa, L.—Common Vetch.—July. Common. (Holmes).

Vicia cracca, L.—Tufted Vetch.—June. Everywhere. (Holmes).

Amphicarpœa monoica, Nutt.—Hog Peanut.—August. Overruns cemetery woods. (Holmes' glycine monoica).

Prunus Americana, Marshall.—Wild Plum. — Around mountain. May.

Prunus Pennsylvanica, L.—Wild Red Cherry.—Common. May. (Holmes).

Prunus Serotina, Ehrhart.—Wild Black Cherry.—Papineau Road and Petite Cote. June.

Prunus Virginiana, L.—Choke-cherry.—Very common. May. (Holmes' P. serotina).

Spiræa salicifolia, L.—Common Meadow-sweet.—Common. August. (Holmes' S. latifolia).

Agrimonia eupatoria, L.—Common Agrimony.—July. Common. (Holmes).

Poterium Canadense, Benth and Hook.—Canadian Burnet. —Savanne, St. Michel. September. (Holmes' sanguisorba Canadensis).

Geum album, Gmelin.—White Avens—.June. Hochelaga woods. (Holmes).

Geum strictum, Ait.—Yellow Avens.—June. Common. (Holmes).

Geum rivale, L. — Purple Avens. — July. Common. (Holmes).

Potentilla Norvegica, L.—Norway Cinque-foil.—July. Common. (Holmes).

Potentilla Canadensis, L. — Canada Cinque-foil. — June. Hochelaga bank. (Holmes' P. simplex).

Potentilla anserina, L.—Silver Weed.—June. Common. (Holmes).

Potentilla fruticosa, L.—Shrubby Cinque-foil.—Savanne, St. Michel. September. (Holmes).

Fragaria Virginiana, Ehrhart.—Common Strawberry.—May. Common. (Holmes).

Fragaria vesca, L.—Sharp Pointed Strawberry.—June. Common in woods.

Rubus odoratus, L.—Purple Flowering Raspberry.—Mountain and elsewhere. June. (Holmes).

Rubus triflorus, Richardson.—Dwarf Raspberry.—Hochelaga banks and elsewhere. May. (Holmes).

Rubus strigosus, Michx.—Wild Red Raspberry.—June. All over the island. (Holmes).

Rubus occidentalis, L.—Black Raspberry.—East side of mountain. June. (Holmes).

Rubus villosus, Ait.—High Blackberry.—North end of mountain. June. (Holmes).

Rubus hispidus, L.—Running Swamp Blackberry.—Swamp between cemeteries. June.

Rosa blanda, Ait.—Early Wild Rose.—East end of mountain. June.

Rosa Carolina, L.—Swamp Rose.—Papineau woods. July. (Holmes).

Rosa rubiginosa, L.—Sweet Brier.—Mountain, Outremont and elsewhere. June. (Holmes).

Cratægus coccinea, L.—Scarlet Fruited Thorn.—Mountain. May. (Holmes).

Cratægus tomentosa, L.—Black or Pear Thorn.—North end of mountain and elsewhere. June. (Holmes).

Cratægus crusgalli, L.—Cockspur Thorn.—North end of mountain. June. (Holmes).

Pyrus arbutifolia, L.—Chokeberry.—Cote St. Paul. June. (Holmes' aronia melanocarpa).

Pyrus americana, D. C.—American Mountain Ash.—June. (Holmes' sorbus Americana).

Amelanchier Canadensis, var. *rotundifolia*, Torr and Gray. —Shadbush.—May. Mountain. (Holmes' aronia ovalis).

Amelanchier Canadensis, var. *Botryapium*, Torr and Gray. —Juneberry.—May. Hochelaga banks. (Holmes' aronia botryapium).

Ribes cynosbati, L.—Wild Gooseberry.—Between cemeteries. May. (Holmes' ribes triflorum).

Ribes hirtellum, Michx.—Small Wild Gooseberry.—June. St. Michel.

Ribes lacustre, Poir.—Swamp Gooseberry.—Hochelaga banks. June. (Holmes).

Ribes floridum, L.—Wild Black Currant. May. Between cemeteries. (Holmes).

Ribes rubrum, L.—Wild Red Currant.—May. Hochelaga banks. (Holmes).

Parnassia Caroliniana, Michx.—Grass of Parnassus.—September. Savanne, St. Michel.

Saxifraga Virginiensis, Michx.—Early Saxifrage.—May. Mountain. (Holmes' S. nivalis).

Mitella diphylla, L.—Two-leaved Mitre-wort.—Base of mountain. May. (Holmes).

Mitella nuda, L.—Naked Stalked Milella.—Hochelaga woods. June. (Holmes' M. cordifolia).

Tiarella cordifolia, L.—False Mitre-wort.—May. Base of mountain. (Holmes).

Penthorum sedoides, Gronov.—Ditch Stonecrop.—Cote St. Paul. July. (Holmes).

Circæa lutetiana, L.—Enchanter's Nightshade.—Hochelaga woods. July. (Holmes).

Circæa Alpina, L.—Small Enchanter's Nightshade.—Mountain. July. (Holmes).

Epilobium angustifolium, L.—Great Willow Herb.—July. Hochelaga woods and elsewhere. (Holmes).

Epilobium palustre, L., var. *lineare*.—Epilobe.—August. (Holmes).

Epilobium molle, Torr.—Epilobe.—August. Cote St. Paul.

Epilobium coloratum, Muhl. — Epilobe Swamp. — St. Michel. (Holmes' E. tetragonum).

Œnothera biennis, L.—Common Evening Primrose.—August. St. Michel and elsewhere. (Holmes).

Œnothera pumila, L.—Small Evening Primrose.—Hochelaga bank. June. (Holmes' Œ. pusilla).

Sicyos angulatus, L.—Star Cucumber.—Fletcher's Field. September. (Holmes).

Sanicula Marilandica, L.—Snakeroot.—June. Mountain. (Holmes).

Daucus carota, L.—Common Carrot.—June. Road-sides.

Heracleum lanatum, Michx.—Cow Parsnip.—Cote St. Paul and elsewhere. June. (Holmes).

Pastinaca sativa, L.—Common Parsnip.—June. Roadsides. (Holmes).

Conioselinum Canadense, Torr. and Gray.—Hemlock Parsley.—Back River and elsewhere.

Cicuta maculata, L.—Spotted Cowbane.—Cote St. Paul. July. (Holmes).

Sium lineare, Michx.—Water Parsnip.—August. Pointe-aux-Trembles. (Holmes).

Carum carui, L.—Caraway.—June. Roadsides, in many places.

Osmorrhiza longistylis, DC.—Smoother Sweet Cicely.—June. Mountain side. (Holmes' Myrrhis longistylis).

Osmorrhiza brevistylis, DC.—Hairy Sweet Cicely.—June. Mountain side. (Holmes' chærophyllum Claytoni).

Aralia racemosa, L.—Spikenard.—North end of mountain. July. (Holmes).

Aralia nudicaulis, L.—Wild Sarsaparilla.—June. Mountain sides and elsewhere. (Holmes).

Aralia quinquefolia, Decaisne. — Ginseng. — Hochelaga woods. May. (Holmes' panax quinquefolia).

Aralia trifolia, Decaisne.—Dwarf Ginseng.—Hochelaga woods and elsewhere. (Holmes).

Cornus Canadensis, L.—Bunchberry.—Papineau woods. June. (Holmes).

Cornus circinnata, L'Her.—Round-leaved Dogwood.—Outremont road. June. (Holmes).

Cornus stolonifera, Michx.—Redosier Dogwood.—July. Common. (Holmes' C. alba).

Linnæa Borealis, Gronov.—Twin-flower. — Hochelaga woods and Cote Michel. July. (Holmes).

Lonicera parviflora, Lam.—Small Honeysuckle.—June. Mountain. (Holmes).

Lonicera ciliata, Muhl.—Fly Honeysuckle.—North end of mountain. May. (Holmes' Xylosteon ciliatum).

Lonicera oblongifolia, Muhl.—Swamp Fly-Honeysuckle.—Buchanan's woods, St. Michel. August. (Holmes).

Diervilla trifida, Mœnch.—Bush Honeysuckle.—July. Mountain. (Holmes).

Sambucus Canadensis, L.—Common Elder.—Mountain sides and elsewhere. June. (Holmes).

Sambucus racemosa, L.—Redberried Elder.—May. Mountain sides and elsewhere. (Holmes' S. Pubescens).

Viburnum opulus, L.—Cranberry Tree.—June. Back River road. (Holmes' V. Oxycoccus).

Viburnum Lentago, L.—Sheepberry.—Cote St Paul. June. (Holmes).

Viburnum acerifolium, L.—Maple-leaved Arrowwood.—June. Monté between St. Michel and Back River. (Holmes).

Lappa officinalis, All., var. *Major*, Gray.—Burdock.—June. Everywhere. (Holmes' arctium lappa).

Cirsium lanceolatum, Scop.—Common Thistle.—August. Everywhere.

Cirsium discolor, Spreng.—Tall Thistle.—August. St. Michel. (Holmes' Cuicus altissimus).

Cirsium muticum, Michx.—Swamp Thistle.—August. St. Michel. (Holmes' cnicus muticus).

Cirsium arvense, Scop.—Canada Thistle.—August. Everywhere. (Holmes' cnicus horridulus).

Xanthium strumarium, L., var. *Echinatum*, Gray.—Common Cocklebur. August. Common. (Holmes).

Ambrosia artemisiæfolia, L.—Hogweed.—August. Everywhere. (Holmes).

Ambrosia trifida, L.—Great Ragweed.—August. Common. (Holmes).

Tanacetum vulgare, L.—Common Tansy.—August. Roadside in many places.

Artemisia vulgaris, L.—Common Mugwort. — August. Everywhere. (Holmes).

Gnaphalium decurrens, Ives.—Everlasting.—August. Common.

Gnaphalium polycephalum, Michx.—Common Everlasting. —August. Common.

Gnaphalium uliginosum, L.—Low Cudweed.—August. Common. (Holmes).

Antennaria plantaginifolia, Hook.—Plantain-leaved Everlasting.—May. Everywhere. (Holmes' Gnaphalium plantaginifolium.

Eupatorium purpureum, L.—Joe Pye Weed.—August. Mountain Park, Cote St. Paul. (Holmes' E. verticillatum).

Eupatorium perfoliatum, L.—Boneset.—August. Mountain Park, Cote St. Antoine. (Holmes).

Eupatorium ageratoides, L.—White Snakeroot.—August. Mountain Park, Cote St. Michel. (Holmes).

Senecio vulgaris, L.—Common Groundsel.—On all streets. July. (Holmes).

Senecio aureus, L.—Golden Ragwort.—August. St. Michel.

Solidago squarrosa, Muhl.—Golden Rod.—East slope of Mountain. August.

Solidago bicolor, L., var., *Concolor*.—Golden Rod.—Mountain base. August. (Holmes).

Solidago latifolia, L.—Golden Rod.—Mountain base. August. (Holmes).

Solidago Cœsia, L., var. *axillaris,* Gray.—Golden Rod.—Mountain base. August. (Holmes' S. livida).

Solidago Canadensis, L.—Golden Rod.—August. Common. (Holmes).

Solidago lanceolata, L.—Golden Rod.—August. Mountain base. (Holmes).

Aster macrophyllus, L. — Starwort. — Mountain sides. August. (Holmes).

Aster azureus, Lindl.—Aster.—Cote St. Paul. August.

Aster cordifolius, L. — Aster. — August. Everywhere. (Holmes).

Aster sagittifolius, Willd. — Aster. — September. Very common. (Holmes).

Aster lævis, L.—Aster.—August. Mountain.

Aster puniceus, L.— Aster. — August. Cote St. Paul. (Holmes).

Aster multiflorus, Ait.—Aster.—August. Cote St. Paul.

Aster tenuifolius, L.—Aster.—August. Mountain base.

Aster acuminatus, Michx. — Starwort. — Park woods. August.

Erigeron Canadense, L.—Horseweed.—August. Papineau Road. (Holmes).

Erigeron bellidifolium, Muhl.—Robin's plantain.—July. Mountain.

Erigeron Philadelphicum, L.—Common Fleabane.—June. South Mountain foot. (Holmes' E. purpureum).

Erigeron strigosum, Muhl. — Daisy Fleabane. — June. Pointe-aux-Trembles. (Holmes).

Erigeron annuum.—Larger Daisy Fleabane.—Cote des Neiges. August. (Holmes' E. heterophyllum).

Leucanthemum vulgare, Lam. — Oxeye Daisy. — June. Everywhere. (Holmes' chrysanthemum).

Anthemis cotula, DC.—Mayweed.—May. Everywhere. (Holmes).

Rudbeckia hirta, L.—Coneflower.—Petite Cote. July.

Helianthus divaricatus, L.—Wild Sunflower.—August. Cemeteries and Park.

Helianthus tuberosus, L.—Jerusalem Artichoke. —August. Prince Arthur street.

Bidens frondosa, L. — Common Beggar Ticks.—July. Fletcher's Field. (Holme's B. pilosa).

Bidens Connata, Muhl.—Swamp Beggar Ticks.—August. Cote St. Paul. (Holmes).

Bidens cernua, L.—Smaller Bur-marigold.—August. Long Pointe. (Holmes).

Achillea millefolium, L.—Milfoil.—June. Everywhere. (Holmes).

Cichorium Intybus, L.—Cichory.—July. Everywhere. (Holmes).

Hieracium Canadensis, Michx.—Canada Hawkweed.—August. Cemeteries. (Holmes' H. kalmii).

Hieracium scabrum, Michx.—Rough Hawkweed.—August. Papineau Road and elsewhere. (Holmes' H. Marianum).

Nabalus albus, Hock.—White Lettuce.—August. Common. (Holmes' prenanthes alba).

Nabalus altissimus, Hook.—Tall White Lettuce.—August. North end of mountain. (Holmes' prenanthes cordata).

Nabalus racemosus, Hook.—Rattlesnake Root.—August. Mountain Park and Cote St. Paul. Common. (Holmes' Prenanthes racemosa).

Taraxacum dens-leonis, Desf.—Common Dandelion.—May. Everywhere. (Holmes' leontodon taraxacum).

Lactuca Canadensis, L.—Wild Lettuce.—North end of mountain. August. (Holmes' lactuca elongata).

Lactuca integrifolia, L.—Wild Lettuce.—August. Cemetery swamp. (Holmes' L. elongata).

Mulgedium leucophæum, DC.—False or Blue Lettuce.—

North end of mountain. August. (Holmes' sonchus leucophæus).

Sonchus oleraceus, L.—Common Sow-thistle.—July. Common. (Holmes).

Sonchus Asper, Vill.—Spring-leaved Sonchus. August. Fletcher's Field and Park.

Sonchus arvensis, L.—Field Sow-thistle.—Cote St. Antoine and St. Michel. August. (Holmes).

Tragopon pratensis, L.—Yellow Goat's Beard.—July. Longue Pointe.

Lobelia cardinalis, L.—Cardinal Flower.—August. St. Michel. (Holmes).

Lobelia inflata, L.—Indian Tobacco.—August. Plateau, north end of mountain. Common. (Holmes).

Campanula Americana, L.—Tall Bell-flower.—Petite Cote and elsewhere on roadsides. August.

Vaccinium corymbosum, L.—Swamp Blueberry.—Hochelaga banks. June. (Holmes).

Pyrola rotundifolia, L.—Wintergreen.—Mountain. July. (Holmes.)

Pyrola elliptica, Nutt.—Shinleaf.—Hochelaga woods. July. (Holmes).

Pyrola secunda, var. *pumila*, L.—Wintergreen.—Hochelaga woods. July. (Holmes).

Chimaphila umbellata, Nutt.—Prince's Pine.—August. Mountain, west side near Cemetery and Buchanan's woods, St. Michel, among pines. (Holmes' pyrola umbellata).

Plantago major, L.—Common Plantain.—August. Common. (Holmes).

Plantago lanceolata, L.—Rib-grass.—August. Common.

Trientalis Americana, Pursh.—Star-flower.—June. Hochelaga woods. (Holmes).

Lysimachia Thyrsiflora, L.—Tufted Loosestrife.—June. Back River. (Holmes' L. capitata).

Lysimachia stricta, Ait.—Loosestrife.—June. Cote St. Paul. (Holmes' L. racemosa).

Lysimachia longifolia, Watt.—Loosestrife.—August. St. Michel.

Verbascum thapsus, L.—Common Mullein.—July. Common. (Holmes).

Veronica anagallis, L. —Water Speedwell.— Lachine. July. (Holmes).

Veronica scutellata, L.—Marsh Speedwell.—August. St. Michel. (Holmes).

Veronica peregrina, L.—Neckweed.—May. Common. (Holmes).

Veronica serpyllifolia, L.—Thyme-leaved Speedwell.—May. Hochelaga banks. (Holmes, at Berthier).

Linaria vulgaris, Mill.—Toad Flax.—July. Common on streets.

Scrophularia nodosa, L. — Figwort. — June. Common. (Holmes' S. Marilandica).

Chelone glabra, L.—Turtle Head.—August. St. Michel and between cemeteries.

Mimulus ringens, L. — Monkey Flower. — Hochelaga. July. (Holmes).

Gerardia tenuifolia, Vahl.—Slender Gerardia.—September. Savanne. St. Michel.

Pedicularis Canadensis, L. — Wood Betony. — May. Mountain base. (Holmes).

Verbena hastata, L.—Blue Vervain.—Hochelaga banks. June. (Holmes).

Verbena urticifolia, L.—Nettleleaved Vervain.—North base of mountain. August. (Holmes).

Phryma leptostachya, L.—Lopseed.—Savanne. St. Michel and mountain. August. (Holmes).

Teucrium Canadense, L.—American Germander.—August. St. Michel. (Holmes, at Boucherville).

Mentha viridis, L.—Spearmint.—Petite Cote. August. (Holmes' M. tenuis).

Mentha piperita, L.—Peppermint.—Point St. Charles. August.

Mentha Canadensis, L.—Wild Mint.—August. Common. (Holmes' M. borealis).

Lycopus Virginicus, L.—Bugle-weed.—Hochelaga woods. August. (Holmes).

Lycopus Europœus, L., var. *Sinuatus*, Gray. — Water Horehound.—August. Common. (Holmes).

Nepeta cataria, L.—Catnip.—July. Common. (Holmes).

Nepeta glechoma, Benth.—Ground Ivy.—Fletcher's Field and elsewhere, near houses.

Lophanthus nepetoides, Benth.—Giant Hyssop.—August. Mountain, near Cote des Neiges toll bar. (Holmes' Hyssopus petoides).

Brunella vulgaris, L.—Common Heal-All.—July. Everywhere. (Holmes' prunella vulgaris).

Scutellaria galericulata, *L.* — Skullcap. — St. Michel. August. (Holmes).

Scutellaria lateriflora, L.—Mad-dog Skullcap.—August. St. Michel. (Holmes).

Galeopsis tetrahit, L.—Common Hemp-nettle.—August, Common. (Holmes).

Stachys palustris, L., var. *Aspera*, Gray.—Hedge-nettle.—Fletcher's Field. (Holmes, at Boucherville Island).

Leonurus cardiaca, L.—Common Motherwort.—August. Papineau common and elsewhere. (Holmes).

Lycopsis arvensis, L. — Bugloss. — June. Common. (Holmes).

Symphytum officinale, L.—Common Comfrey.—East side of mountain, near Cote des Neiges Road. June.

Echinospernum lappula, L. Lehm.—Stickseed.—June. Common. (Holmes' Myosotis Lappula).

Cynoglossum officinale, L.—Common Hound's Tongue.—June. Common. (Holmes).

Lithospermum hirtum, Lehm. — Hairy Puccoon.—May. Common.

Lithospermum officinale, L.—Common Gromwell.—May. Common. (Holmes).

Myosotis palustris, Withering, var. *laxa*, Gray.—Forget-me-not.—Pointe-aux-Trembles. June.

Myosotis arvensis, Hoffm.—Field Myosotis.—Cemetery Swamp. August.

Hydrophyllum Virginicum, L.—Waterleaf.—June. Base of mountain and elsewhere. (Holmes).

Calystegia sepium, R. Br.—Hedge Bindweed.—St. Michel Road. August. (Holmes' convolvulus sepium).

Calystegia spithamæa, Pursh.—Bracted Bindweed.—Back River. June. (Holmes' convolvulus stans, at Three Rivers.)

Convolvulus arvensis, L.—Bindweed.—July. Fletcher's Field.

Hyoscyamus niger, L.—Black Henbane.—St. Famille street, Fletcher's Field and elsewhere. (Holmes).

Datura stramonium, L.—Common Thorn Apple.—St. Lawrence suburbs. August. (Holmes).

Gentiana Andrewsii, Griseb.—Closed Gentian.—St. Michel. August.

Apocynum androsæmifolium, L.—Dogbane.—June. Mountain. (Holmes).

Asclepias Cornuti, Decaisne.—Common Milkweed.—July. Common. (Holmes' A. Syriaca).

Fraxinus Americana, L.—White Ash.—Between Petite Cote and St. Michel, along fence. June. (Holmes' F. Epiptera).

Fraxinus pubescens, Lam.—Red Ash.—Same locality. June.

Fraxinus sambucifolia, Lam.—Black Ash.—St. Michel woods. June. (Holmes).

Chenopodium album, L.—Lamb's Quarters.—July. Everywhere. (Holmes).

Chenopodium murale, L.—Pigweed.—August. Upper St. Urbain street.

Chenopodium hybridum, L.—Maple-leaved Goosefoot.—West side of mountain. August. (Holmes).

Blitum capitatum, L. — Strawberry Blite.— Fletcher's Field. August. (Holmes).

Atriplex patula, L.—Orache.—July. Everywhere on streets. (Holmes).

Amarantus retroflexus, L.—Pigweed.—August. Everywhere. (Holmes).

Polygonum aviculare, L.—Goose-grass.—August. Everywhere. (Holmes)

Polygonum incarnatum, Ell.—Knotweed.—August. Cote St. Paul.

Polygonum Pennsylvanicum, L —Knotweed.—August. St. Urbain street. (Holmes).

Polygonum Persicaria, L.—Lady's Thumb.—July. Everywhere. (Holmes).

Polygonum amphibium, var. *aquaticum*, L.—Water Persicaria.—St. Michel. August. (Holmes).

Polygonum hydropiperoides, Michx.—Mild Water Pepper. —August. Cote St. Paul. (Holmes).

Polygonum acre, H. B. K.—Water Smartweed.—Petite Cote. August.

Polygonum hydropiper, L.—Common Smartweed.—August. Common.

Polygonum sagittatum, L.—Arrow-leaved Tear Thumb.— Mountain. August. (Holmes).

Polygonum convolvulus, L.—Black Bindweed.—Grain fields. August. (Holmes).

Polygonum dumetorum, L., var. *Scandens*, Gray.—Climbing False Buckwheat.—Cote St. Paul. (Holmes' P. Scandens).

Rumex orbiculatus, Gray.—Great Water Dock.—St. Michel, Savanne. August.

Rumex crispus, L. — Curled Dock. — July. Common. (Holmes).

Rumex obtusifolius, L.—Bitter Dock.—Cote des Neiges. August. (Holmes).

Rumex acetosella, L.—Sheep Sorrel.—May. Everywhere. (Holmes).

Fagopyrum esculentum, Mœnch.—Buckwheat.—Fletcher's Field and elsewhere. August.

Dirca palustris, L.—Leatherwood.—Petite Cote. April. (Holmes).

Euphorbia hypericifolia, L.—Spurge.—August. Fletcher's Feld and elsewhere.

Euphorbia humistrata, Engelm. — Spurge. — August. Fletcher's Field.

Euphorbia obtusata, Pursh. — Spurge. — St. Lawrence suburbs. August.

Euphorbia platyphylla, L. — Spurge. — St. Lawrence suburbs. August.

Euphorbia Helioscopia, L.—Sunspurge.—July. Everywhere. (Holmes).

Euphorbia peplus, L.—Spurge.—August. Fletcher's Field and mountain base.

Euphorbia cyparissias, L.—St. Famille street and elsewhere. July.

Acalypha Virginica, L.—Three Seeded Mercury.—St. Famille street and elsewhere, very common. August. (Holmes' A. Caroliniana).

Ulmus fulva, Michx.—Slippery Elm.—April. Common. (Holmes).

Ulmus Americana, L.—White Elm.—April. Common. (Holmes).

Ulmus racemosa, Thomas.—Corky White Elm.—May. Along roadsides.

Urtica gracilis, Ait.—Nettle.—August. Along fences. (Holmes' U. procera).

Laportea Canadensis, Gandichaud. — Wood Nettle. — August. Back River. (Holmes' Urtica divaricata).

Cannabis sativa, L.—Hemp.—July. Common. Along roadsides. (Holmes).

Juglans cinerea, L.—Butternut.—Mountain sides and Petite Cote. (Holmes).

Carya amara, Nutt.—Swamp Hickory.—Petite Cote and mountain. May. (Holmes).

Carya alba, Nutt.—Shellbark Hickory.—West side of mountain. May. (Holmes).

Quercus rubra, L.—Red Oak.—May. Mount Royal. (Holmes).

Quercus macrocarpa, var *Olivæformis*, Gray.—Bur Oak.—May. St. Laurent and elsewhere. (Holmes).

Fagus ferruginea, Ait.—American Beech.—May. West side of Mount Royal. (Holmes).

Corylus rostrata, Ait.—Beaked Hazel Nut.—June. Base of mountain. (Holmes' C. anellana).

Ostrya Virginica, Willd.—Iron Wood.—May. Mountain. (Holmes).

Betula lenta, L.—Black Birch.—May. Hochelaga woods.

Betula papyracea, Ait.—Canoe Birch.—May. Mountain. (Holmes).

Betula populifolia, Ait.—Gray Birch.—Petite Cote. May. (Holmes).

Alnus incana, Willd.—Speckled Alder.—April. Mountain foot. Common. (Holmes' A. serrulata).

Alnus viridis, DC.—Green Alder.—Between mountains. May. (Holmes' A. undulata).

Salix humilis, Marshall.—Prairie Willow.—Hochelaga bank. May.

Salix discolor, Muhl.—Glaucous Willow.—North base of mountain.

Salix petiolaris, Smith.—Petoiled Willow.—Savanne, St. Michel. August.

Salix livida, Wahl., var. *occidentalis*, Gray.—Livid Willow.—All over the island. May.

Populus tremuloides, Michx.—American Aspen.—May. All over the island. (Holmes).

Populus balsamifera, L.—Balsam Poplar.—May. Common.

Populus monilifera, Ait.—Cottonwood.—Upper St. Famille street. May. (Holmes' P. angulata).

Populus monilifera, Ait., var. *Candicans*, Gray.—Balm of Gilead.—May. St. Famille street.

Populus alba, L.—White Poplar.—Cote St. Antoine and elsewhere. May.

Pinus strobus, L.—White Pine.—May. Savanne, St. Michel. (Holmes).

Pinus Banksiana, Lambert.—Scrub Pine.—Mountain. May.

Abies balsamea, Miller.—Balsam Fir.—Hochelaga woods. May. (Holmes' pinus balsamea).

Picea nigra, Link.—Black Spruce.—Petite Cote. May.

Picea alba, Link.—White Spruce.—St. Michel. May.

Tsuga Canadensis, Carr—Hemlock.—Hochelaga woods. May.

Larix Americana, Michx. — Tamarack. — Petite Cote Swamp. May.

Thuja occidentalis, L.—Cedar.—May. In all swamps on island.

Juniperus communis, L. — Common Juniper.—Between mountains. August.

Taxus Canadensis, L., var. *Canadensis*, Gray.—Ground Hemlock.—Mountain. May. (Holmes).

Arisæma triphyllum, Torr.—Indian Turnip.—June. Mountain swamp. (Holmes' Arum triphyllum).

Calla palustris, L.—Marsh Calla.—Petite Cote Swamp. June.

Typha latifolia, L.—Common Cat Tail.—Pointe-aux-Trembles and elsewhere. July. (Holmes).

Typha angustifolia, L.—Narrow-leaved Cat Tail.—Pointe-aux-Trembles. June.

Sparganium simplex, Hudson, var. *Angustifolium*, Gray.—Bur Reed.—June. Back River.

Alisma plantago, L., var. *Americanum*, Gray.—Water Plantain.—July. Cote St. Paul. (Holmes).

Sagittaria variabilis, Engelm.—Arrowhead.—July. Common. (Holmes' S. sagittifolia).

Habenaria tridentata, Hook.—Rein Orchis.—Woods near cemetery gate. June.

Habenaria orbiculata, Torr. — Rein Orchis.— Between cemeteries. July.

Spiranthes Romanzoviana, Chamisso.—Ladies' Tresses.—Savanne, St. Michel. July.

Cypripedium pubescens, Willd. — Large Yellow Lady's Slipper.—West side of mountain. June. (Holmes).

Cypripedium acaule, Ait.—Stemless Lady's Slipper.—June. Hochelaga woods. (Holmes' C. arietinum).

Iris versicolor, L.—Larger Blue Flag.—June. Common.

Sisyrinchium anceps, Cav.—Blue-eyed Grass.—June. Common. (Holmes).

Smilax herbacea, L.—Carrion Flower.—St. Laurent. June.

Trillium grandiflorum, Salisb.—Large White Trillium.—May. Very common. (Holmes).

Trillium erectum, L.—Purple Trillium.—Mountain, Hochelaga woods and elsewhere. (Holmes).

Trillium erythrocarpum, Michx.—Pointed Trillium.—May. Hochelaga woods. (Holmes).

Medeola Virginica, L.—Indian Cucumber Root.—June. Hochelaga woods. (Holmes).

Uvularia grandiflora, Smith.—Bellwort.—Papineau Road and mountain. May. (Holmes).

Uvularia sessilifolia, L.—Wood Daffodil.—May. North end of mountain. (Holmes).

Clintonia borealis, Raf. — Clintonia. — June. Mountain marsh and Hochelaga woods. (Holmes' convallaria borealis).

Streptopus roseus, Michx.—Twisted Stalk.—May. Moun-

tain and Hochelaga woods. (Holmes' convallaria polygonatum).

Smilacina racemosa, Desf.—False Spikenard. North end of mountain. August. (Holmes' convallaria racemosa).

Smilacina stellata, Desf.—False Solomon's Seal.—Lachine and elsewhere. (Holmes' convallaria stellata).

Smilacina bifolia, Ker., var. *Canadensis*, Gray.—False Solomon's Seal.—June. Mountain and Hochelaga woods. (Holmes' convallaria bifolia).

Polygonatum biflorum, Ell.—Smaller Solomon's Seal.—May. West side of mountain. (Holmes' convallaria angustifolia).

Erythronium Americanum, Smith. — Yellow Adder's Tongue.—May. Mountain and elsewhere. (Holmes' E. dens-canis).

Polypodium vulgare, L.—Polypody.—North end of mountain. June. (Holmes).

Adiantum pedatum, L.—Maidenhair.—June. Mountain. (Holmes).

Pteris aquilina, L. — Brake. — August. Common. (Holmes).

Asplenium filix fœmina, Bernh.—Spleenwort.—Mountain base.—June. (Holmes' A. angustifolium).

Aspidium thelypteris, Swartz.—Shield Fern.—Mountain base. (Holmes' athyrium thelypteris).

Aspidium Noveboracense, Swartz.—Wood Fern.—Mountain foot. June.

Aspidium marginale, Swartz. —Shield Fern. —Mountain base. July. (Holmes).

Onoclea sensibilis, L.—Sensitive Fern.—August. Hochelaga woods. (Holmes).

Osmunda regalis, L. — Flowering Fern. — Hochelaga woods. (Holmes).

Osmunda Claytoniana, L.—Osmunda.—August.—Hochelaga woods. (Holmes' O. interrupta).

Osmunda Cinnamomea, L.—Cinnamon Fern.—August. Hochelaga woods. (Holmes).

Botrychium Virginicum, Swartz.—Moonwort.—July. North end of mountain. (Holmes' B. Gracile).

Equisetum limosum, L.—Horse Tail.—May. Hochelaga. (Holmes).

Equisetum arvense, L.—Common Horse Tail.—May. Everywhere. (Holmes).

Equisetum hyemale, L.—Scouring Rush.—June. North base of mountain.

Equisetum variegatum, Schleicher.—Horse Tail.—June. Cote St. Paul.

Equisetum scirpoides, Michx.—Horse Tail.—Mountain base. July.

Lycopodium dendroideum, Michx.—Ground Pine.—August. Hochelaga banks. (Holmes).

Lycopodium clavatum, L.—Club Moss.—August. Hochelaga woods. (Holmes).

Lycopodium lucidulum, Michx.—Club Moss.—Savanne, St. Michel. August. (Holmes).

The Utica Terrane in Canada.

By Henry M. Ami, M.A., F.G.S., of the Geological Survey of Canada.

(*Continued from page* 183.)

In the vicinity of Pointe aux Trembles, above Quebec, the following species were noted in a collection made by Sir Wm. Logan and his staff in 1852 (?) :—

1. *Diplograptus pristis ?* Hisinger.
2. *Orthograptus quadrimucronatus*, Hall.
3. *Climacograptus bicornis ?* Hall.
4. *Ptilodictya* (?) sp.
5. *Anazyga recurvirostra*, Hall.
6. *Modiolopsis* sp.
7. *Calymene callicephala*, Green.

From Cape Santé, the following species have been identified from a collection placed in the writer's hands in 1882 :—

1. *Cyathophycus reticulatus*, Walcott.
2. *Orthograptus quadrimuneronater*, Hall.
3. *Dendrograptus* sp.
4. *Leptobolus insignis*, Hall.
5. " *sp.*
6. *Leptæna sericea*, Sowerby.
7. *Pterinea insueta*, Conrad.
8. *Endoceras proteiforme*, Hall.
9. *Triarthrus Becki*, Green.

From a small collection of fossils labelled "Grondines," north side of the St. Lawrence, the following three forms were observed :—

1. *Climacograptus bicornis ?* Hall.
2. *Diplograptus pristis ?* Hall.
3. *Leptobolus insignis*, Hall.

From a collection of fossils from St. Antoine de Tilly—made by Mr. Weston—in 1887, there occurs several portions of *Triarthrus Becki*, Green, in good state of preservation, and from along the "Grève de Beauport." L'Abbé Laflamme sent a slab of shaly rock to the museum of the Geological Survey, on which there were seen :—

1. *Climacograptus sp.*
2. *Leptobolus insignis*, Hall.
3. *Triarthrus Becki*, Green.

whilst on a similar slab, which from Charlesbourg, Que., Prof. Laflamme collected, the following forms occurred :—

1. *Orthograptus quadrimucronatus*, Hall.
2. *Leptobolus insignis*, Hall.
3. *Triarthrus Becki*, Green.

West of Pointe-aux-Trembles, near Quebec the Utica shales have not been observed to crop out from beneath the the overlying till, or from under the overlying Hudson River terrane, except in the vicinity of Montreal. Here, this formation, as well as most of the Cambro-Silurian or Ordovician strata occurring in the neighbourhood, have

suffered or been subjected to consideraable elevation, and consequent denudation, on account of the volcanic masses occurring at this locality. At Joliette, or "Industry Village," however, a small collection of fossils was made in 1852 by Sir William Logan, and contains the following species, which point clearly to the presence of or decided close proximity to the Utica terrane, whence these specimens were collected. They are:—

1. *Strophomena alternata*, Conrad.
2. *Leptæna sericea*, Sowerby.
3. *Orthis testudinaria*, Dalman.
4. *Asaphus Canadensis*, Chapman.

From an interesting collection made by Thos. Curry, of the Redpath Museum in connection wlth McGill University, at the northern extremity of the Victoria Tubular Bridge, Point St. Charles, Montreal, the following species were identified by the writer:—

1. *Climacograptus sp.*
2. *Leptograptus flaccidus*, Hall.
3. *Orthograptus quadrimucronatus*, Hall.
4. *Diplograptus sp.*
5. *Orthis testudinaria*, Dalman.
6. *Leptobolus insignis*, Hall.
7. *Cornulites immaturum*, Hall.
8. *Endoceras proteiforme*, Hall.

The shales in which the above were found are dark grey and bituminous, somewhat more calcareous than the shales of the Utica usually are, and somewhat indurated or altered, on account of the presence of the numerous dykes of syenite and trap which occur in this district. Not only near the above mentioned locality, but at the upper or western extremity of St. Helen's Island, opposite Montreal, the Utica is seen to crop out with its characteristic fossils.

Amongst the most recent additions to the knowledge of the Utica and its fauna about Montreal is the occurrence of a series of shales seen at low water last season (1891), which yielded the following forms:—

1. *Dendrograptus simplex*, Walcott.
2. *Reteograptus ? Eucharis*, Hall.

3. *Orthograptus quadrimucronatus*, Hall.
3. *Climacograptus Scharenbergi ?* Lapw.
5. *Endoceras proteiforme*, Hall.
6. *Triarthrus Becki*, Green.

The Utica is also seen to crop out at and above Longueuil and then sweep round to the south by Laprairie, and is then overlaid by the Hudson River shales of Chambly, St. Hyacinthe, &c. Its measures have been examined by Dr. Ells in the 4th Range, near Clarenceville, Que., during the summer of 1891, who made an interesting collection, in which the following fossils were detected :—*Cyathohhycus reticulatus*, Walcott, *Climacograptus sp.*, *Orthograptus quadrimucronatus*, Hall, *Endoceras proteiforme*, Hall, and *Triarthrus Becki*, Green.

Near Lacolle, Que., one-eighth of a mile west of the Richelieu River Bridge Dr. Ells also obtained *Orthograptus quadrimucronatus*, Hall, and *Triarthrus Becki*, Green, which serve clearly to show that the Utica proper is here developed. About half a mile east of this village, however, and in the river alongside the road to Grand Trunk Station, the same gentleman has brought in a suite of specimens which yielded the following forms on examination :—

1. *Climacograptus bicornis ?* Hall.
2. *Diplograptus* cf. *D. mucronatus*. Hall.
3. *Leptæna sericea*, Sowerby.
4. *Triarthrus Becki*, Green.

South of here the belt of the Utica crosses the international boundary line, as stated above, and curving south, west and then trending north crosses the waters of Lake Ontario to reach the Province of that name—forming a belt of several miles in breadth—whose strata are almost horizontal with a gentle almost imperceptible dip to the southwest.

Along the line of the Grand Trunk Railway, in some low cuttings, as well as in a number of localities between the lake and the track where openings were made for quarry and other purposes the Utica may be seen. About Oshawa and Bowmanville, the black bituminous and brittle shales of this terrane are evident and fossiliferous.

An interesting collection was made by the writer in 1883 at Whitby on a farm and lot, the property of Mr. Yerex, south of the G.T.R. track close to where a bore hole was put down by a company many years ago in order to find coal or petroleum. It was in spite of Sir Wm. Logan's assertions and statements regarding the strata in this neighbourhood not being coal-bearing or "carboniferous" that the company sank the hole and found that as soon as the bituminous shales capping the Trenton were traversed, the limestones formed a compact and solid thickness of rock beneath. It is almost needless to state here that neither coal nor petroleum were "struck" at this point, and furthermore that neither of these substances occur in this region. Except the very small percentage of oil which can be extracted from the more bituminous shales of the Utica here as elsewhere—no reservoir of petroleum or occurrence of that mineral oil can be obtained in the rocks of this age.

The fossil remains found at the pit or quarry, close to the bore-hole, Whitby, belong precisely to the same geological horizon as the shales in the vicinity of the Rideau Rifle Range, Ottawa, or as the shales at Collingwood to be described later on.

The species recorded from this locality are:—

1. *Leptograptus flaccidus*, Hall.
2. *Orthograptus quadrimucronatus*, Hall.
3. *Leptobolus insignis*, Hall.
4. *Lingula* sp.
5. *Leptæna sericea*, Sowerby.
6. *Zygospira modesta*, Say.
7. *Lyrodesma pulchellum*, Emmons.
8. *Trocholites ammonius*, Emmons.
9. *Endoceras proteiforme*, Hall.
10. *Primitia Ulrichi*, Jones.
11. *Asaphus Canadensis*, Chapman.
12. *Triarthrus Canadensis*, Smith.
13. *Triarthrus Becki*, Green.
14. *Crustacean*, ? (cf. fragment of *Echinognathus Clevelandi*, W.)

Then, following northward the belt of Utica crosses the Province of Ontario and is covered by a great deal of drift

or superficial deposits belonging to glacial, inter-glacial and lacustrine deposits so as to cover it almost totally, reappears in the vicinity of Nottawasaga Bay, near Collingwood and Windsor, where it can be easily recognized by its lithological characters and fossils. The list of species collected by Mr. A. S. Cochrane, of the Geological Survey of Canada, at Collingwood, in 1887, and determined by the writer comprises the following forms:—

1. *Obscure Graptolite*, probably a *Diplograptus* cf. *D. pristis*, Hisinger.
2. *Lingula Progne*, Billings.
3. " sp.
4. *Orthis testudinaria*, Dalman.
5. *Leptæna sericea*, Sowerby.
6. *Strophomena alternata*, Conrad.
7. *Rhynchonella increbescens ?* Hall.
8. *Lyrodesma pulchellum*, Emmons.
9. *Endoceras proteiforme*, Hall.
10. *Primitia Ulrichi*, Jones.
11. *Beyrichia sp.*
12. *Triarthrus Becki*, Green.
13. *Asaphus Canadensis*, Chapman.

The absence of *Leptobolus* in this list is almost phenomenal, inasmuch as the *L. insignis* of Hall occurs in large numbers, as a rule, in rocks of precisely the same horizon in other parts of Canada.

In the northern portion of Lake Huron and the Manitoulin Islands, where the Utica again crops out after disappearing beneath the waters of Georgian Bay, or where the shales, soft, friable, and easily denuded, have been carried away along the line of a great pre-glacial river, it is seen on St. Joseph's Island, in the islands north of Maple Cape, and along the shores of the Shequenandod Bay and Islands. At the last mentioned locality—Shequenandod Bay and Islands—the following fossil remains have been determined by the writer:—

1. *? Dendrograptus simplex*, Walcott.
2. *? Climacograptus bicornis*, Hall.
3. *Orthograptus quadrimucronatus*, Hall.
4. *Leptobolus insignis*, Hall.

5. *Primitia, Ulrichi*, Jones.
6. *Endoceras proteiforme*, Hall.
7. *Triarthrus Becki*, Green.

The above forms occur in a rather poor state of preservation in a somewhat indurated and calcareous black bituminous shale.

From the islands north of Maple Cape the following species were determined by the writer in 1882:—

1. *Sagenella ambigua*, Walcott.
2. *Ptilodictya ? sp.*
3. *Monticuliporidæ.*
4. *Leptobolus insignis*, Hall.
5. *Streptorhynchus filitextum ?* Hall.
6. *Rhynchonella increbescens*, Hall.
7. *Lingula Progne*, Billings.
8. *Primitia Ulrichi*, Jones.
9. *Triarthrus Becki*, Green.
10. " *Canadensis*, Smith.

Amongst the specimens of *Triarthrus Canadensis*, Smith, found in this collection, one specimen is especially worthy of note. It exhibits the two characteristic spines attached to the freecheeks, the glabella, and eight body segments attached to the head. Several pygidia also occur in the collection, which may properly belong to this species. From a second collection of fossils examined from Collingwood, evidently collected by the late Alex. Murray early in the fifties, during his examination of the geographical distribution of the Lower Silurian formations belonging to the New York and Ontario systems, there are *nineteen* species found, as follows. The collection is labelled "Nottawasaga Bay, Collingwood, Ont.":—

1. *Diplograptus pristis ?* Hisinger.
2. *Dictyograptus vel. Dictyonema sp.*
3. *Crinoidal fragments.*
4. *Lingula obtusa*, Hall.
5. " *Progne*, Billings.
6. " *quadrata*, Eichwald.
7. *Leptobolus insignis*, Hall.
8. *Orthis testudinaria*, Dalman.
9. *Streptorhynchus filitextum*, Hall.

10. *Strophomena alternata*, Conrad.
11. *Leptæna sericea*, Sowerby.
12. *Pleurotomaria sp.*
13. *Conularia Hudsonia*, Emmons.
14. *Orthoceras lamelloum*, Hall.
15. *Endoceras proteiforme*, Hall.
16. *Primitia Ulrichi*, Jones.
17. *Asaphus platycephalus*, Stokes.
18. " *Canadensis*, Chapman.
19. *Triarthrus Becki*, Green.

On the "west side St. Joseph's Island," Lake Huron, a number of specimens thus labelled, probably collected by Mr. Murray also, indicated the presence of *Leptobolus insignis*, Hall, and *Orthis testudinaria*, Dalman, the latter being unusually large, and resembling a form which approaches *O. emacerata*, Hall.

The above localities and lists of fossils from various portions of Quebec and Ontario present the leading characteristics of the Utica as it is seen to crop out along the contour or edge of the archæan continent—in contact with it at times, and then overlapping the older members of the Ordovician system; at other times occurring as a more or less narrow belt of black bituminous strata lying intermediate between the Trenton and the Hudson River, but throughout an almost uninterrupted belt of continuous strata from Anticosti to the Manitoulin Islands. As can readily be seen the notes and remarks above made are from a palæontological standpoint, and show the distribution and continuity of existing forms of life during Utica times as the shales were being deposited in the old Ordovician sea.

Besides the above localities occurring along this continuous belt or zone of Utica, there are two well-known palæozoic basins, that of Lake St. John and Ottawa in which this terrane is well developed and in which there are numerous and varied forms of animal life entombed. This points clearly to the fact that in Utica times and in these two isolated and quite separate basins, similar conditions of deposition, sedimentation and conditions under which life existed were present in those early days similar to the conditions outside of those basins.

Lake St. John Basin.

From the Lake St. John and Upper Saguenay district the explorations of Sir Wm. Logan, James Richardson, Scott Barlow, Dr. Selwyn, Prof. Laflamme, Mr. F. D. Adams, Mr. D. N. Saint Cyr and others have afforded a considerable quantity of material wherewith to ascertain by means of the fossils to what age or precise geological horizon the different strata there met with belonged. As early as 1829, in a report by Captain F. H. Baddeley, addressed to the Legislature of Quebec, the black bituminous schists of the Utica were recorded in this Lake St. John or Upper Saguenay district. From the collections made by Mr. Richardson, Billings described the *Triarthrus glaber* of Lake St. John as a new and undescribed form. This trilobite is the largest one of the genus yet known, and the specimens obtained by Mr. Adams in 1883 and 1884 show that its dimensions vary greatly, and even surpass those mentioned in the type specimens.

From the "Mouth of the Ouatchouan River," Lake St. John, Mr. Adams obtained the following species in a rusty weathering somewhat indurated black bituminous shale:—

1. *Orthograptus quadrimucronatus*, Hall.
2. *Leptobolus insignis*, Hall.
3. *Endoceras proteiforme*, Hall.
4. *Triarthrus glaber*, Billings.

Amongst the specimens of *T. glaber*, collected by Mr. Adams, we find that the occipital or neck segment is furnished with a small somewhat depressed linear tubercle about the centre, a character which had not heretofore been noted in this species. The fact that it is destitute of genal spines, of spines along the median axis of the body or attached to the occipital segment as in T. spinosus, and that the body segments of this species (T. glaber) are destitute of the tubercules along the median axis of the body, is quite sufficient warrant to retain the designation *glaber* for this Lake St. John species, although it does possess one occipital tubercle as single ornamentation visible.

It would thus appear that all the known Canadian species of Triarthrus possess this tubercle on the occipital segment, viz.: *T. Canadensis*, Smith; *T. Becki*, Green; *T. Fischeri*, Billings; *T. glaber* and *T. spinosus*, Billings and *T. Billingsi*, Barrande.

It was from the Lake St. John district that the Utica slate graptolites: *Graptolithus flaccidus*, *Graptolithus quadrimucronatus*, and *Reteograptus ? Eucharis*, were described by Hall in 1865, "Canadian Organic Remains," decade II., pp. 143-147 (supplement.) The precise locality given is Blue Point, Lake St. John.

A peculiar organism occurs in the collection made by Dr. Selwyn, whose affinities are still doubtful. In some respects it has the character and structure of *Megalograptus* (Miller), and in others of a peculiar crustacean type. Further collections may afford better examples of this form whose affinities still remain unknown.

The Ottawa Outlier.

In the Ottawa Palæozoic Basin the Utica terrane is fairly well developed, and numerous as well as interesting exposures may be seen, especially in the vicinity of Ottawa city. In the townships of Plantagenet and Alfred two outliers of the Utica are recorded by Sir William Logan. No fossil remains have been seen from these outliers by the writer, but the Utica terrane about Ottawa has afforded him an excellent opportunity of studying its character and facies, as the outcrops are numerous and varied. Besides the natural exposures along the banks of the Rideau River, from the village of New Edinburgh up to near Billings' Bridge, along the Montreal Road and by the Beechwood Cemetery, as well as underlying almost the whole of Centre and Upper Town west of the canal and south of Sparks Street, with a slight dislocation along Bank Street, which brings the Utica shales in front of the Supreme Court buildings, and south of Rochesterville, as already cited, the Utica was examined by the writer along numerous pits and in excavations made by the city engineer or contractors of

public buildings, throughout the city. From the lower, middle and upper divisions of the Utica, fossil remains have been found, most of which have already been recorded in scattered pages and pamphlets published by the writer since 1882.

I shall not attempt to describe at length the various outcrops as they were examined by me and recorded about Ottawa. Suffice it to state that Rideau Ward, Cummings' Bridge, the Rideau Rifle Range, the Montreal Road, excavations along Albert, Kent, Bank, O'Connor and Maria Streets, have afforded numerous collections of fossil remains, many of which were hitherto unrecorded or altogether new to science.

The following is a condensed list of the species of fossils from the Utica of Ottawa and its vicinity :—

UTICA FOSSILS FROM OTTAWA AND ITS ENVIRONS.

HYDROZOA.

Leptograptus annectans, Walcott sp.
" *flaccidus*, Hall.
Diplograptus mucronatus ? Hall.
" *pristis ?* Hisinger.
" *putillus*, Hall.
" *quadrimucronatus*, Hall.
Sagenella ambigua, Walcott.

BRYOZOA.

Stictopora acuta, Hall.

BRACHIOPODA.

Leptobolus insignis, Hall.
" *occidentalis ?* Hall.
Siphonotreta Scotica, Davidson.
Lingula Daphne, Billings.
" *obtusa*, Hall.
" *Progne*, Billings.
" *quadrata*, Eichwald.
Orthis testudinaria, Dalman.
" *emacerata*, Hall.
Schizocrania filosa, Hall.
Leptæna sericea, Sowerby.

Strophomena alternata, Conrad.
Zygospira Headi, Billings.

LAMELLIBRANCHIATA.

Lyrodesma pulchellum, Hall.
Modiolopsis modiolaris, Hall.
Orthodesma parallelum, Hall.
Pterinea insueta, Conrad.
" *Trentonensis*, Conrad.

PTEROPODA.

Conularia Hudsonia, Emmons.
" *Trentonensis*, Hall.

GASTEROPODA.

Bellerophon bilobatus, Sowerby.
Murchisonia Milleri, Hall.
Pleurotomaria subconica, Hall.

CEPHALOPODA.

Trocholites ammonius, Conrad.
Endoceras proteiforme, Hall.
" " var. *tenuistriatum*, Hall.
Orthoceras amplicameratum, Hall.
" *coralliferum*, Hall.
" *lamellosum*, Hall.

ANNELIDA.

Serpulites dissolutus, Billings.

CRUSTACEA.

Asaphus Canadensis, Chapman.
" *platycephalus*, Stokes.
Calymene senaria, Conrad.
Cheirurus pleurexanthemus, Green.
Triarthrus Becki, Green.
" *glaber*, Billings.
" *spinosus*, Billings.
Leperditia cylindrica, Hall.

as per "*Classified List of Cambro-Silurian and Post-Tertiary Fossils from Ottawa and Vicinity*," published by the writer in 1884.

To the above may be added:—

1. *Stephanella sancta*, Hinde.
2. *Batostonella erratica*, Ulrich.

3. *Arthronema* sp.
4. *Lingula elongata*, Hall.
5. " *Cobourgensis*, Billings.
6. *Pholidops* sp.
7. *Discina Pelopea*, Billings.
8. *Anazyga recurvirostra*, Hall.
9. *Zygospira modesta*, Say.
10. *Modiolopsis anodontoides*, Conrad.
11. *Metoptoma* sp.
12. *Cornulites immaturum*, Hall.
13. *Beyrichia oculifera*, Hall.
14. *Primitia Ulrichi*, Jones.
15. " *mundula*, Jones.
16. *Turrilepas Canadensis*, Woodward.

Appended to this is a classified table of the genera and species characterizing the Utica of Canada, giving also a series of localities in the United States, typical localities as Utica, Holland Patent, &c., for comparison.[1]

From the same and the foregoing it will clearly be seen and naturally deduced that the so-called Utica or Hudson River shales of Quebec city, Cape Diamond, of the Marsouin River beds, of Norman's kiln and "Coenograptus" shales in general do not occur anywhere in Canada where the Utica shales are found in their natural and undisturbed position between the Trenton and Hudson River terranes.

These belong to a district and separate terrane—the Quebec terrane of the writer—and are characterized by a fauna whose affinities are more closely related to Lower Ordovician (Levis) faunas than to an upper member of the Ordovician system.

[1] This portion of the paper will appear in a subsequent issue of the CAN. REC. OF SCIENCE.—EDITOR.

NOTES ON CAMBRIAN FAUNAS.

BY G. F. MATTHEW, ST. JOHN, N.B.

DEVELOPMENT OF THE FAUNA OF BAND *b* IN THE ACADIAN DIVISION (*Div.* 1) OF THE ST. JOHN GROUP.

In Eastern Canada, as in many other parts of the world, the earliest palæozoic rocks have comparatively few and they, scattered relics of the life which existed on the world when these rocks were formed. Hence we find in the geological literature of fifty years ago, when the sequence of faunas in the so-called transition rocks had not been established, the assumption that the rocks which contained few fossils were Cambrian, and those in which remains of an abundant life existed were assumed to be Silurian.

A problem of a similar kind awaits, or rather exercises, the palæontologist of the present day, for while the sequence of faunas in the Paradoxides beds and above, where fossils are comparatively abundant, is well understood, some confusion and uncertainty surrounds the effort to determine accurately the succession of animals in the Cambrian rocks below that horizon; an uncertainty largely due to the scarcity of organic remains in the older sediments.

As regards the fauna of Band *b* (Pre-Paradoxides beds) in this region, some information had been obtained and will be found on record chiefly in the Transactions of the Royal Society of Canada [1], but in view of the fact that no unquestionable representative of the genus Olenellus had been found in these beds, I embraced an opportunity to send my son, W. D. Matthew, to make further explorations at Hanford Brook, where Band *b* is exposed, for examples of this genus of trilobites. Although unsuccessful in finding Olenellus he made other discoveries which are perhaps of more value in broadening our knowledge of the faunas which preceded Paradoxides, than the discovery of that

[1] For reference to this information consult the page references in the explanation of the plates of vol. iii. sec. iv. p. 81, vol. v. sec. iv. pp. 126 and 129, vol. vii. sec. iv. reference at p. 161.

genus would have been, and thus are of value to the palæontologist.

Perhaps the most important of these was the finding of material representing an interesting and, I think, hitherto unrecognized generic group of trilobites, whose species seem to have given some difficulty to the geologists who discovered them. These species have been referred with doubt to three several genera by the authors who described them, but in none of the three do I think they can be included.

The writer proposes first to describe the new genus and two species of another genus of this Band, and then endeavour to correlate the forms with those of other regions.

PROTOLENUS[1] Matt.

(Natural History Society of New Brunswick, Bulletin X.)

Head-shield semicircular, moderately vaulted, outer part of the cheek movable, prolonged at the genal angle into a spine.

Middle piece of the head more or less quadrate. Anterior margin wide and having a narrow distinct fold at the rim. Glabella conical, or cylindro-conical, prominent, marked by furrows on the sides. Occipital ring distinct, separated from the glabella by a furrow. Fixed cheek of variable width, bordered by a long, continuous or nearly continuous eyelobe. Extension of the dorsal suture, both in front of the eye and behind it, more or less direct to the margin.

Movable cheek regularly curved, area wider than the distinct fold, spine usually long.

Thorax of many joints, pleuræ grooved for a part of their length, slightly geniculate, curved backward in the outer part, extended into points or spines.

Pygidium in the Canadian species unknown (small?), in the Sardinian species like that of Paradoxides.

This genus belongs to the family of Olenidæ, and its most obvious features are the long conical glabella, the long con-

[1] *Protos* first, *olenus* as one of the Olenidæ.

tinuous or nearly continuous eyelobe and the olenoid pleuræ.

It differs from Olenellus by its free cheeks, from Paradoxides, Olenoides and Zacanthoides by its conical glabella, from Olenus by its continuous eyelobes, from Anomocare by its narrow rim and numerous thoracic segments, from Solenopleura by its less tumid cheeks, depressed anterior margin, long eyelobes and olenoid pleuræ, from Conocophalites (sens. strict.) by its long eyelobe, short posterior extension of the dorsal suture and its olenoid pleuræ.

Two Acadian species (*P. elegans* and *P. paradoxoides*) of this genus are known and are described in Bulletin X. of the Natural History Society of New Brunswick. (See also figures 1 *a-b* and 2 *a-d*, with this paper.)

ELLIPSOCEPHALUS (Zenker).

This genus has long been known in Europe, but on this side of the Atlantic, except a broken head-shield found near the base of Band *b* of the St. John group, and provisionally referred to this genus, it has not been recognized. As limited by Linnarsson to its typical forms it has but a narrow range in the lowest Cambrian beds. Its latest species appears to be *E. Hoffi* (Fig. 6), of Bohemia, found there with Paradoxides (*P. Bohemicus*). Another species, *E. polymetopus*, is found with the oldest type of Paradoxides in Sweden (*P. Œlandicus*), which is also the oldest type in Eastern Canada (*P. lamellatus.*) A third species (*E. Nordenskjoldi*) is found in Europe (Norway and Sweden) with the Olenelloid trilobite, *Holmia Kjerulfi*. From these facts we gather that the range of the genus (sens. strict.) is in the top of the Olenellus zone and the lower half of the Paradoxides zone. The genus has not been recognized in America anywhere west of the Acadian region.

ELLIPSOCEPHALUS GALEATUS, n. sp. Figs. 4 *a-e*.

Head shield subelliptical, with rounded corners, strongly vaulted, the front slope nearly at right angles with the posterior part of the shield.

Middle piece of the head shield subquadrate, rounded in front. Anterior margin greatly depressed, and bordered by an inconspicuous fold, front area very wide and long. Glabella cylindrical, somewhat expanded and curved downward in front, faintly impressed at the sides by four pairs of furrows, of which the anterior is short and sometimes obsolete. Occipital ring convex, curved forward at the ends, and separated from the glabella by a strong furrow. Fixed cheeks convex, sloped downward at the sides and depressed before and behind; ocular fillet slender, extending from the dorsal furrow to the eyelobe, which is moderately arched. Dorsal suture directed outward and forward in front of the eyelobe, but behind it extends direct to the posterior margin. Posterior fold and furrow distinct.

Thorax of 11 + segments; rachis prominent, pleura shorter than the ring, obtuse at the ends, crossed by an oblique furrow.

Sculpture. Under the lens this is seen to consist of numerous, minute granulations.

Size. Length of the middle piece measured parallel to the axis of the body 11 mm.; measured around the curve of the head shield, 14 mm.; width, 14 mm.; Length of the movable cheek, 7 mm.; width, 2 mm.; length of a segment of the body, 13 mm.; width, 2 mm.

Horizon and *Locality.* The gray sand stones of 1, *b*, ^{3}, at Hanford Brook, St. John Co., N.B.

A variety, *agrauloides* has a flatter shield, and an area, narrower and less bent downward in front.

ELLIPSOCEPHALUS ARTICEPHALUS. Matt.

Agraulos (?) *articephalus.* Trans. Roy. Soc. Can., Vol. III. Sec. IV. p. 75. pl. VII. figs. 14 *a* & *b*.

Of this species originally described as *Agraulos* (?) *articephalus* much better examples have been found than were known when the species was discovered, and the description of the species is here restated.[1]

[1] Where the characters are at variance with the original description the words are in italics.

"The cephalic shie'd between the sutures is oblong-subquadrate. Glabella large, long ovato-*cylindrical* somewhat pointed in front, marked by three pairs of furrows, which are directed backward. Fixed cheek *rather narrow*, eyelobe *distant from the glabella about two-thirds of the width of the latter*, *beginning* opposite the third furrow; the cheeks are depressed in front of the eyes, and are united in front of the glabella; the united cheeks descend and are depressed toward the anterior margin, and there is *a low marginal fold.*

"The facial suture is parallel in its general course to the longitudinal axis of the shield; it cuts the margin obliquely, curving inward *slightly* between the margin and the eyelobe * * * it then curves outward along the eyelobe and returns again and cuts the posterior margin as far from the glabella as the space from the *ocular fillet to the front* of the head-shield."

"The thorax tapers regularly toward the base; only the first seven segments are known; the axis is wide and high, and the rings strongly arched; the pleuræ appear to be shorter than the ring, they are strongly arched, and bent downward at the extremity."

"The pygidium is unknown."

Sculpture. The surface is smooth over most of the crust, but the area in front of the glabella is traversed by branching and anastomosing raised lines.

Size. The specimen originally described was a young, incomplete head. The following is given as the dimensions of the adult: Head shield between the sutures, length, 11 mm.; width, 12 mm.

There are other features of the surface contour of this species worthy of notice; there are distinct furrows about the front and sides of the shield unusual in species of the genus Ellipsocephalus; beside the dorsal furrow, which is distinctly impressed around the front of the glabella, two furrows branch on each side from the anterior lateral angles of the glabella and extend, the one along the front of the ocular fillet and the other along the back of it, the latter

quite around the outer margin of the cheek; a lighter furrow crosses the ocular fillet diagonally causing the fillet to assume in some examples a tubercular form. There is also a minute tubercle on the occipital ring.

The ocular lobes were wanting in the specimen on which the original description of this species was founded, and it was not recognized as an Ellipsocephalus, and even now that the head is completely known, the agrauloid features of the glabella are remarkable; this part of the head is slightly conical, is somewhat angulated in front and has furrows, all of which are directed strongly backward. The posterior glabella furrow, in well preserved examples, shows a thread-like extension, which turns backward and outward and reaches the occipital furrow: the second furrow is prolonged backward until the two parts almost meet on the axis of the glabella at an acute angle.

There is considerable variation in the surface markings of this species; sometimes the raised lines on the front area are absent, the glabellar furrows are obscure and the surface of the test generally smooth. This may have been caused by the wear of the crusts as they lay scattered on the sandy bottom; for as the heads of different species are found packed within each other, they seem to have been rolled or washed about on the bottom of the sea before entombment.

Comparison with other species—Protolenus.

Under the name of Olenus, Prof. G. Meneghini some years ago described two species of trilobites from the Cambrian rocks of Sardinia, which resemble the species the writer here places under the generic name Protolenus. Although referred by Meneghini to Olenus, in many respects these species of Sardinia differ from that genus, yet both are evidently of the family of the Olenidæ. Their long eyelobes associate them with the Acadian species described above; one (*O. armatus*) is rather imperfectly known, but the other, *O. Zoppii* (Fig. 3), is well shown by various figures

and one or two complete examples.[1] To the writer it appears that the latter species, if not both, belongs to Protolenus. The eyelobes in the Sardinian species are not so continuous as in the Acadian, but this may indicate merely a later development of the type, similar to that which occurred in Paradoxides, whose earlier species, and also whose embryonic forms show more continous eyelobes than the later species and the adult forms.

Under the names of *Solenopleura* (?) *Harveyi* and *S.* (?) *Howleyi*[2], Mr. C. D. Walcott has described two species of trilobites from Newfoundland, which are evidently closely allied to *Protolenus elegans*. In fact *S.* (?) *Howleyi* appears to differ only in the more advanced position of the eyes, the peculiar occipital furrow, and the absence of spines at the ends of the pleuræ. The spines of the pleuræ in this species may have been overlooked, for in the Acadian species, *P. elegans*, they are quite slender. There can be no doubt but that *S.* (?) *Howleyi* is a Protolenus.

Under the name of *Olenellus* (?) *Forresti*, Etheridge, Jr.,[3] Mr. A. H. Foord has described a Cambrian trilobite from Western Australia, which also apparently may be included in the genus Protolenus. This, like the Acadian species, has a conical glabella and continuous eyelobes, but the eyelobes are close to the glabella, leaving a very narrow fixed cheek. The eyelobes and margin of the middle piece of the head-shield are well defined, and give no reason for supposing that the outer cheek was fixed, without which the reference to Olenellus is inadmissable. In fact the author who described the species implies that the outer cheeks were free. The pleuræ figured by Mr. Foord is evidently one belonging to an olenoid trilobite.

[1] "Fauna Cambriana—Trilobiti," In memoirs of Geological Commission of Italy, vol. iii. pt. 2nd.

[2] Fauna of the Lower Cambrian or Olenellus Zone, p. 657. N.B.—There is an error in indexing the Plate xcvii, in which this species is figured; the description in the text shows that Fig. 7 represents *S. Howleyi* and Fig. 8 *S. Harveyi*. Reverse also the page references.

[3] There is an obvious error in the description of this species, where at the sixth line "widening" should be *narrowing*.

In the later of the two Acadian species of Protolenus (*P. paradoxoides*) there is a narrowing of the fixed cheek and prolonging of the glabella (as compared with the earlier species, *P. elegans*), which, carried further, would give rise to a trilobite similar in the form of the head to *O.* (?) *Forresti*. It appears to the writer therefore that this species should also be included in Protolenus.

Ellipsocephalus.

As already remarked no species of this genus has hitherto been satisfactorily shown to exist in America, and it is necessary to look to the Old World for species which may be compared with those existing in Eastern Canada.

In the Holmia Kjerulfi beds of Sweden are two trilobites which have many points of resemblance to the two Ellipocephali described in this article.[1] It is true that one of these species is referred to Arionellus, but it possesses an extended eyelobe and in other respects does not fully accord with that genus; the points of departure are all in the direction of Ellipsocephalus, and thus it appears to correspond with *E. articephalus*, only it has a much wider glabella.

Similarly the other species is a counterpart in many respects of *E. galeatus* only the Swedish form has not so wide a front margin, nor the cylindrical glabella, bell shaped in front, of a typical Ellipsocephalus. Still these two trilobites not inadequately represent the two Ellipsocephali described above.

It may be mentioned in this connection that Mr. Walcott has described a new genus of Cambrian trilobites under the name of Avalonia, which by the form of the glabella and fixed cheek is allied to Ellipsocephalus, if indeed it be not a sub-genus of that group.[2] It will be observed that the species *E. articephalus* has a furrow across the shield in

[1] De Undre Paradoxides lagren, Stockholm, 1883, p. 20, tab. iv. figs. 1, 2 and 4.

[2] The eyelobes on the figure appear to have been introduced by the artist, as they are not mentioned in the description of the genus.

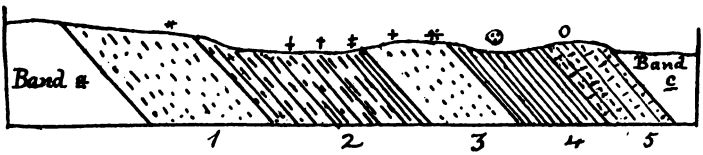
front of the glabella, similar to that of Avalonia, and also a similar furrow inside of the eyelobe.

Correlation of Faunas based on these four species.

A visual representation is often an important aid to the memory, and as preliminary to remarks under this head, I may here introduce a section of the Band *b*. of Division 1, in which the Ellipsocephali and Protoleni have been found.

The section is enlarged from one which appeared in the Transactions of the Royal Society of Canada, 1889, and is presented for the purpose of showing the position of the fossiliferous layers discovered by W. D. Matthew.

Section of the Band *b* of Division 1 of the St. John group at Hanford Brook—Scale, 80 feet to an inch.



* Hipponicharion Eos, Ellipsocephalus (?) *c. f.* polymetopus, etc.

† Protolenus elegans and Beyrichona tinea.

‡ Protolenus elegans, Ellipsocephalus grandis, Beyrichona, etc.

+ Ellipsocephalus galeatus, Acrothele, etc.

÷E. galeatus and E. articephalus, Protolenus paradoxoides Conocephalites (?) Beyrichona tinea, etc.

●Beyrichona tinea and B. papilio.

○Acrothele, Acrotreta, Linnarssonia, etc.

Fossiliferous horizons of Band *b* of the Acadian Division (Div. 1) chiefly as determined by W. D. Matthew. The section shows also the relation of Band *b* to the Paradoxides beds above (*c—d*) and to the barren sandstones or quartzites (*a*) at the base of the St. John group. It is enlarged from one at page 139, Vol. VII. (IV.) Trans. Roy. Soc. Can., where further relations of the St. John group are exhibited, and where, at page 142, the original description of this section is given.

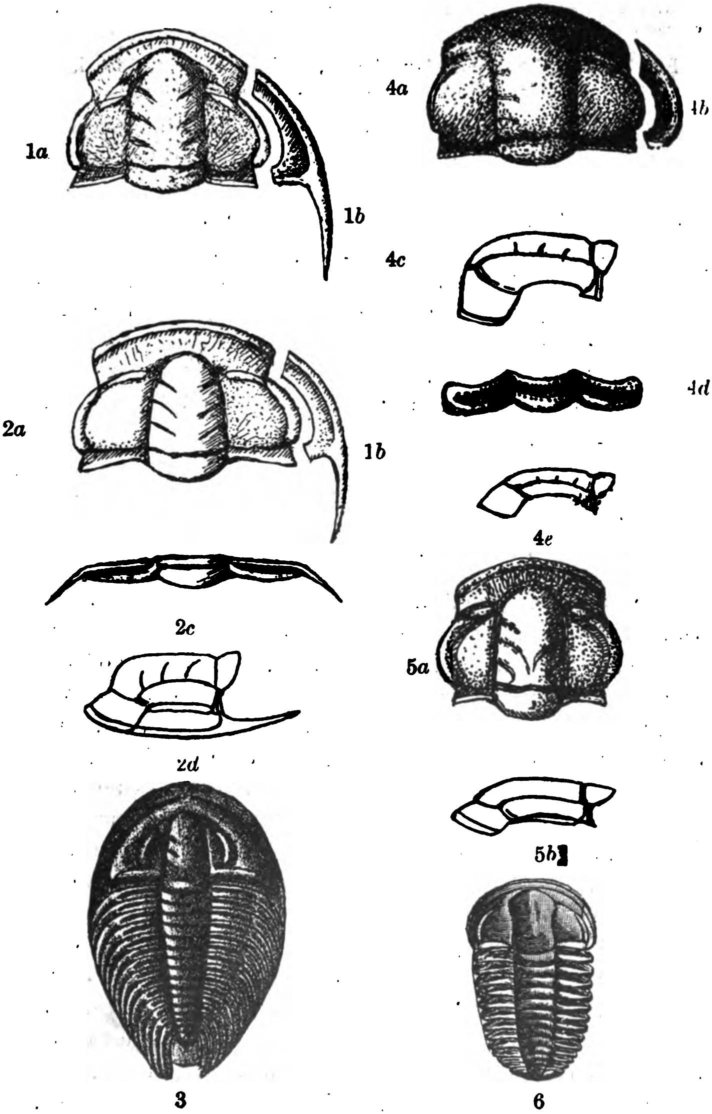
Protolenus (*P. elegans*) is first found in the middle of the shales of 2 (see section) but it becomes more abundant in the upper third of this number of Band *b*, and is accompanied by an ostracod, *Beyrichona tinea*, which also occurs in the next two numbers, 3 and 4. Near the top of the "2" shales, Protolenus is accompanied by an Ellipsocephalus, not, however, the species of the sandstone number 3, but a larger species *E. grandis*, (M.S.) In the sandstones the Protolenus has disappeared and these beds in the lower part have yielded no trilobite. But about the middle of the sandstones *Ellipsocephalus galeatus* comes in and toward the top there is a somewhat diversified fauna of trilobites including *E. galeatus*, *E. articephalus*, and *Protolenus paradoxoides*. On account of the abundance of the Ellipsocepli in the sandstones of 3, this member may be regarded as the zone of Ellipsocephali.[1]

And as *Protolenus elegans* is the characteristic species of the shales which constitute 2, these shales are to be regarded as the zone of Protolenus—a new horison between the two sandstone numbers 1 and 3, whose faunas have already been to some extent known.

In conclusion a synopsis may here be introduced, suggestive of the bearing of these discoveries on the probable chronological relation of several species of the genus Olenellus, as inferred from their companion species (of which representative species occur in the subfaunas of the Band *b*.).

	Acadian Species.	*Eastern Species*	*Olenelli.*
Band *b* 3.	Ellipsocephalus galeatus.	Ellipsocephalus Nordenskjoldi.	Holmia. Kjerulfi.
Band *b* 2.	Protolenus elegans.	Protolenus Howleyi.	Holmia. Bröggeri.
Band *b* 1;	?	?	Mesonacis. Mickwitzi.

[1] Band *b* has already been spoken of as the zone of Agraulos [=Ellipsocephalus] articephalus. See Trans. Roy. Soc. Can. vol. viii–iv. p. 129.


1a
1b
4a
4b
4c
2a
1b
4d
4e
2c
5a
2d
5b
3
6

Reference to Plate.

N.B. The reader should notice that numbers are not always nearest to the figures they designate.

Fig. 1.—*Protolenus paradoxoides*—*a*, Middle piece of the head-shield—*b*, Movable cheek. Both natural size.

Fig. 2.—*Protolenus elegans*—*a*, Middle piece of the head-shield—*b*, Movable cheek—*c*, A pleura—*d*, Head-shield in profile. All natural size.

Fig. 3.—*Protolenus Zoppii* (*Olenus Zoppii* Meneghini.)

Fig. 4.—*Ellipsocephalus galeatus*—*a*, Middle piece of the head-shield—*b*, Movable cheek—*c*, Middle piece in profile—*d*, A pleura—*e*, *var. agrauloides* head-shield in profile. All magnified $\frac{2}{1}$.

Fig. 5.—*Ellipsocephalus articephalus*—*a*, Middle pice of the head-shield—*b*, Same in profile. Both magnified $\frac{2}{1}$.

Fig. 6.—*Ellipsocephalus Hoffi*. Barrande.

The Folk-Lore Society.

The first meeting of the winter course of the Montreal Branch of the American Folk-Lore Society, took place on the evening of Monday, the 10th inst., at the house of Mrs. L. Fréchette, 408 Sherbrooke Street. The attendance was fair, and several new members gave their names to the Secretary. Professor Penhallow, first Vice-President, took the chair in the absence of the President, Mr. Beaugrand. He gave a brief account of his visit to Boston during the summer, and of the doings and plans of the Society in that city. Arrangements had been made for the holding of a Folk-Lore Congress at Chicago, under the auspices of the American Folk-Lore Society, and of the American Association for the Advancement of Science. One of the latest movements for the collection of popular usages is a scheme for taking the street cries and criers of the large cities by means of phonograph. Efforts are being simultaneously made in Boston, Philadelphia, New Orleans and Chicago, to this end, and the task in Montreal has been undertaken

by the Ladies' Committee of the Branch, who so far have had satisfactory success.

The Secretary, Mr. Reade, gave the substance of correspondence that he had had, since last meeting, with the Societies of New Orleans, Boston and Chicago, with which he had, at their request, promised to exchange reports of proceedings. The chairman than called upon Mr. Reade to give his paper on "Opportunities for the study of Folk-Lore in Canada." The essayist introduced the subject with a brief sketch of the history of Folk-Lore organization and study in Great Britain, the continent of Europe, especially France, the United States and Canada, and mentioning a number of periodicals that were entirely devoted to this branch of research. The Montreal Branch of the American Folk-Lore Socioty was the result of a movement begun by Prof. Penhallow and a few others, last February, the formal inauguration of the branch taking place in April, Mr. W. W. Newell, Secretary of the general Society, coming to Montreal for the purpose. Mr. Reade, having shown the relations of Folk-Lore to ethnology and mythology, characterized it as the stored-up knowledge of the folk or people, consisting largely of survivals of habits of thought or social and ceremonial customs of a more or less remote past. It included the whole vast background of popular thought, feeling and usage, out of which, and in contrast to which had been developed all the individual products of human activity that go to the making of history. The essayist then gave a succinct statement of the racial constituents of Canada, pointing out that every one of the various groups that composed our complex nationality had its own myths, tales, traditions, superstitious beliefs, ballads, dialects, etc., so that no matter where one lived between the Atlantic and the Pacific, in town or country, among French or British or German or Aborigines, descendants of U. E. Loyalists or people of old country stock, he was at no loss for interesting and valuable data. From Ferland's history and other sources, including the censuses, from those of the 17th century to the last, Mr. Reade

showed in what way Canada had been settled and where the folk-lorist had the best opportunities with regard to each race or nationality. He next gave a summary of what had already been done in the way of Folk-Lore research by Abbé Petitot, Mr. H. Hale, Dr. F. Boas, Mr. A. F. Chamberlain, Abbé Maurault, Dr. G. M. Dawson, Mr. James Deans, the late Dr. Rand, Mrs. W. W. Brown, the Rev. John McLean, Father Lacombe, Rev. E. F. Wilson, Mr. Fréchette, Mr. R. G. Haliburton, Mr. Beaugrand, etc. He also referred to the colonies of Norsemen, Russians, Hungarians, Roumanians, Chinese, etc., settled in Western Canada, all with strongly marked racial features in their social, religious and industrial life. Finally, the essayist called attention to the mass of virtually forgotten lore to be found in the works of Champlain, the Jesuits' Relations, Charlevoix, de Gaspé, the writings of travellers, Nor. Westers (including the Hon. Mr. Masson's excellent series) Mr. Canniff Haight's "Country Life in Canada," the writings of Messrs. LeMoine, Sulte, F. de Saint Maurice, and numerous other works of the past and present.

After a short discussion, Mr. Fréchette read a paper, entitled "La Corriveau," based on a double murder and two-fold trial—the latter of which took place in the year 1763, near the close of the *Règne Militaire*, and was a striking illustration of the legal barbarism of the time. It was, however, in the superstitions that gathered around the unhallowed spot where the murderess was hanged in chains and enclosed within an iron cage, that the interest of the story for folk-lorists mainly consisted. We would gladly give a fuller account of Mr. Fréchette's thrilling paper, which was read in excellent English, had not the author expressed a wish that it should not be published—the publication of it being already arranged for.

After music, conversation and refreshments, the meeting separated, with the understanding that the Society should meet again at a place to be designated by the Ladies Committee, on the second Monday in November, when Prof. Penhallow would read a paper on "Epitaphs."

...Y, 1892.

...feet, C. H. McLEOD, *Superintendent.*

DAY.	...OUDED ...NTHS. Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	1	77	....	....	. ..	1
	0	76	....	....	...	2
SUNDAY.. .		82	0.99	....	0.99	3 . . SUNDAY
	0	61	0.30	....	0.30	4
	0	96	....	....	....	5
	0	99	....	...		6
	0	96	...	....	....	7
	0	40	0 21	....	0.21	8
	9	00	0.58	....	0 58	9
SUNDAY	..	77	Inap.	....	Inap.	10 ....SUNDAY
	0	67	....	....	....	11
	0	56	....	...	..	12
	2	35	Inap.	...	Inap.	13
	0	97	....	....	....	14
	0	79	0 02	....	0.02	15
	0	16	0.12	...	0.12	16
SUNDAY ...	..	79	Inap.	....	Inap.	17 ...... SUNDAY
	0	97	....	....	....	18
	0	20	Inap.	....	Inap.	19
	0	100	0.01	....	0.01	20
	0	98	....	....	....	21
	0	58	0.04	....	0 04	22
	0	98	....	....	....	23
SUNDAY....	..	26	Inap.	...	Inap.	24 ... ..SUNDAY
	0	65	0.14	....	0 14	25
	1	90	Inap.	....	Inap.	26
	0	65	Inap.	....	Inap.	27
	0	33	0.11	...	0.11	28
	0	36	0.43	....	0.43	29
	0	97	....	....	....	30
SUNDAY....	..	61	....	....	....	31 ....SUNDAY
....	...	68	2.95	...	2 95	Sums ....
18 Years ... for and inc... this month..	....	¶59.1	4.13	...	4.13	18 Years means for and including this month.

...and

Direction...

Miles .....

Duration in...

Mean velo...

...the

Greatest ...g a 11th and 16...

...nest

Greatest ... the 12th. ...6th.

Highest barometer reading was 30.522 on the 7th; lowest barometer was 29.512 on the 16th, giving a range of 1.010 inches. Maximum relative humidity was 98 on the 15th and 25th. Minimum relative humidity was 35 on the 27th

Rain fell on 18 days.

Rain or snow fell on 18 days.

Auroras were observed on 6 nights.

Solar halos on the 1st and 2nd.

Thunderstorms on 3 days.

Fog on 3 days.

ABSTRAC

Meteorological Observations, McGill Colle

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	• BA Mean.	§ Ma
1	71.20	80.8	64.6	16.2	29.9963	30.02
2	66.85	71.5	64.7	6.8	29.9783	30.00
3	70.12	78.6	63.8	14.8	29.9400	29.97
4	69.02	77.2	63.0	14.2	29.8545	29.90
5	64.43	73.8	55.9	17.9	29.8780	29.94
6	63.75	73.8	58.0	15.8	29.7960	29.93
SUNDAY.......7	.....	75.3	52.9	22.4	....	.....
8	74.23	83.2	62.0	21.2	29.8427	29.97
9	72.30	79.3	68.8	10.5	29.7378	29.82
10	70.67	82.5	64.8	17.7	29.8692	29.92
11	65.42	71.8	60.1	11.7	29.8548	29.90
12	58.83	62.3	58.2	4.1	29.9260	29.94
13	58.35	63.8	54.9	8.9	29.8715	29.87
SUNDAY........14	.....	70.6	57.0	13.6	....	.....
15	68.23	75.8	58.5	17.3	30.0323	30.06
16	71.17	80.6	58.2	22.4	30.0680	30.11
17	72.58	81.5	66.2	15.3	30.0268	30.06
18	71.82	78.3	65.0	13.3	30.0560	30.08
19	71.28	86.2	59.3	26.9	29.9968	30.12
20	61.98	77.6	54.2	13.4	30.0388	30.12
SUNDAY.......21	.....	74.6	53.3	21.3	....	.....
22	64.50	72.3	59.0	13.3	30.1040	30.19
23	63.07	72.8	54.2	18.6	30.2132	50.28
24	66.20	73.7	60.5	13.2	30.0797	30.14
25	60.75	66.4	59.5	6.9	29.8968	29.95
26	62.72	69.8	57.0	12.8	30.0893	30.16
27	56.60	63.7	53.2	20.5	30.1815	30.20
SUNDAY........28	.....	70.9	51.2	19.7	......	..
29	64.57	75.8	54.0	21.8	30.0903	30.14
30	67.93	79.9	57.5	22.4	29.9543	30.07
31	63.37	70.8	58.7	12.1	29.7737	30.81
..........Means	66.37	74.7	59.0	15.7	29.9680	
18 Years means for and including this month. ..	66.91	75.4	58.8	16.4	29.9425	...

ANALYSIS OF WIND REC

Direction....	N.	N.E.	E.	S.E.	S.	S.W.
Miles	778	1596	218	361	240	772
Duration in hrs ..	109	105	37	47	45	70
Mean velocity....	7.14	15.20	5.89	7.68	5.33	11.03

Greatest mileage in one hour was 41 on the 12th.
Greatest velocity in gusts, 50 miles per hour on the 12th.
Resultant mileage, 3005.

Resultant
Total mile
Average ve

... FOR THE MONTH OF AUGUST, 18..

... Montreal, Canada. Height above sea level, 187 feet.

	WIND.		SKY CLOUDED IN TENTHS.		
	General direction.	Mean velocity in miles per hour.	Mean.	Max.	Min.
	W.	[illegible]	5.5	10	0
	N.E.	[illegible]	10.0	[illegible]	10
	W.	[illegible]	[illegible]	[illegible]	[illegible]
	W.	[illegible]	[illegible]	[illegible]	[illegible]
	N.	[illegible]	[illegible]	[illegible]	[illegible]
	W.	[illegible]	[illegible]	[illegible]	[illegible]
	W.	[illegible]	[illegible]	[illegible]	[illegible]
	S.W.	[illegible]	[illegible]	[illegible]	[illegible]

ER, 1892.

t, C. H. McLEOD, *Superintendent.*

	DED HS. Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	0	63	....	....	....	1
	0	100	....	....	....	2
	0	96	....	....	....	3
SUNDA	..	67	....	....	....	4 .... SUNDAY
	0	89	0.09	....	0.09	5
	0	85	0.11	....	0.11	6
	0	93	....	....	....	7
	0	94	....	....	....	8
	0	99	....	....	....	9
	0	52	....	....	....	10
SUNDA	..	48	....	....	....	11 ....SUNDAY
	0	68	....	...	....	12
	10	00	0.16	....	0.16	13
	0	15	0.82	....	0.82	14
	0	52	Inap.	....	Inap.	15
	0	87	....	....	....	16
	0	94	....	....	....	17
SUNDA	..	95	....	....	....	18 .... SUNDAY
	0	40	0.42	....	0.42	19
	0	97	....	....	....	20
	0	86	....	....	...	21
	8	00	0.08	....	0.08	22
	0	00	0.04	....	0.04	23
	0	29	0.03	....	0.03	24
SUNDA	..	10	....	....	....	25 ....SUNDAY
	2	00	1.17	....	1.17	26
	0	43	....	....	....	27
	0	94	....	....	...	28
	0	90	....	....	....	29
	3	73	....	....	..	30
......	....	62	2.92	....	2.92	Sums ....
18 Y for and this m	....	¶50.6	3.19	....	3.19	18 Years means for and including this month.

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Re

Highest barometer reading was 30.442 on the 8th; lowest barometer was 29.341 on the 26th, giving a range of 1.101 inches. Maximum relative humidity was 98 on the 24th and 25th. Minimum relative humidity was 45 on the 2nd and 29th

Rain fell on 10 days.

Auroras were observed on 3 nights.

Lunar halo on 1 night.

Thunderstorm on 1 day.

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VOLUME V. **NUMBER 5.**

THE CANADIAN
RECORD OF SCIENCE

INCLUDING THE PROCEEDINGS OF
THE NATURAL HISTORY SOCIETY OF MONTREAL,
AND REPLACING

THE CANADIAN NATURALIST.

CONTENTS.

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THE

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The Cabinet Anticlinal.

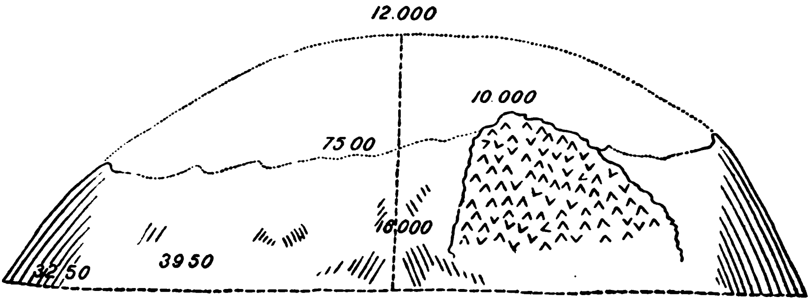
By Herbert R. Wood.

A short study of a range of mountains on the border lines of Idaho and Montana, known as the Cabinet Range, developed a few interesting facts which I have noted down. The range has a trend, or the axis of the anticlinal has a trend 20° to 25° E. of south for a distance of 30 miles, the Kootenai River cutting through it near its upper end. It forms no doubt a spur, a broken continuation of the Kootenai Range in Southern British Columbia, or a southern extension of Dawson's[1] Gold Range which is known farther south as the Cœur d'Alene and Bitter Root Ranges. The rocks consist of graphitic slates or shales which have a black streak, dark argillites near the central portions of the Anticlinal which has a probable width of 8 or 10 miles, heavily bedded quartzites of greenish grey color, compact or more coarse, and of a dull red color, owing to oxidation.

No evidences of fossils were obtained in the rocks, though graptolites were looked for. A number of veins parallel with the strike of the anticlinal and near the axial line, carrying argentiferous galenas, are in the black graphitic

[1] See Dawson on Mineral Wealth of British Columbia.

Fig. 1.



shales, thin-bedded quartzites, which I observed only along the axial portions. The above figure shows a transverse section of the anticlinal taken at Snow Shoe Gulch, twenty miles south-east of the Kootenai. The heights given are barometrical measurements, save that given as 10,000 feet, (which is the height of Mount Ibec as recorded by an English traveller who made the ascent). The western flank of the range which I did not examine, however, closely—is the least denuded, and has resisted the abrasion of the ice, because of a granitic upthrow which extends north and south for eight or ten miles or more. A number of parallel streams flowing east have their sources in the snows of the higher western flank, deep gulches having been formed four and five miles in length with an east and west trend.

Glacial striations are observable along the flanks of the gulches. The grooved and polished surfaces of rocks along the sides of the gulches, show glacial striæ 43° W. of south. This gulch rises about 300 feet per mile and is perhaps three miles in length. The dip 35° E.N.E. as secured at Cherry Creek, which flows along the eastern flank of the range, represents the outer eastern margin of the anticlinal fold, which is about four miles from the axis of the fold, or to the point marked on the figure as 5,200 feet above the sea. Roughly speaking the thickness of the upheaved

strata is from 12,000 to 15,000 feet. Taking four miles as the length of the base line from the outer edge of the anticlinal to the centre or axis, and the angle as 35° at which the strata at this extreme eastern margin of the fold dip east, the length of the vertical is 12,000 feet, showing a great area of denudation of at least 4,500 feet. Much of this detrital material is piled along the eastern flanks at the mouth of the gulch on the already denuded strata, which denudation preceded the glacial period. As to the exact age of the rocks, I am as yet in doubt. The evidence I have obtained is as follows: One hundred miles east of this point the lower Cambrian quartzitic series is found, consisting of heavily bedded greyish quartzites, pinkish-red quartzites, and red argillites and sandstones. In the interval a great anticlinal of more than one fold is observed. The rocks are greyish-black slates, quartzites, shales, etc. The margin of the Cambrian ocean extended apparently then along the eastern flank of the Bitter Root Range, a series of Huronian slate-schists being largely denuded, which is a bedded quartz porphyry and gneiss with distinct granitic areas, the whole coeval with Pilot Knob of South Eastern Missouri, north westerly along 114° to Tobacco Plains at the 49th parallel and thence into British Columbia. In the Correlation of the Cambrian series by Walcott, it will be seen on page 323, that he says "the Cambrian rocks of Montana are restricted to the southern portion of the strata." This is undoubtedly an error since I have examined them south of the boundary and still farther south of this in the vicinity of Missoula, ripple marks, cross-bedding, and all the evidences abound of marginal shallows and shore lines. This peculiar series of rocks I have not observed west of this. Selwyn notes[2] a series of graphitic slates and shales in which no fossils were found in British Columbia. He is inclined to call them Cambro-Silurian (ordovician). Dawson[3] says, "Granites and crystalline schists of great age are abundant in the Gold

[2] See Mineral Wealth of British Columbia, p. 63.

[3] Dawson Mineral Wealth of British Columbia, p. 8,

Range, together with great masses of palæozoic rocks, respecting the structural relations of which very little is as yet known." Considering their position, the character of the rocks, the absence of fossils, their relationship both to the ranges of British Columbia and the southern country (the Cœur d'Alene and Thompson Falls country), I am inclined to call them pre-Cambrian or Huronian.

This upheaval occurred in all probability during the Palæozoic period when the rocks to the east constituting the Cambrian (Upper Cambrian ?) were upheaved. The denudation so enormous has extended over many geological epochs. The range appears to be intersected with dikes of fine grained diabase, but they were not observed in situ save in one instance. Dynamically considered this fold is of great interest. A series of dips and strikes show a variation from the eastern limit of the fold as follows (taken at Snow Shoe Gulch) :

Strike 20° E. of S.;	Dip 38° S. E.;	Elevat. 3,250 feet, 4 miles from axis.
Strike 15° E. of S.;	Dip 45° E.;	Elevat. 5,000 feet, 300 yds. from axis.
Strike 20° E. of S.;	Dip 67° E.;	Elevat. 5,600 feet, 30 yds. from axis.

There is a number of mellow flexures along the base of the gulch about the central portions of the anticlinal one of 60 ft. in width at its apex, another 100 ft. broad. The rocks take a nearly vertical dip, then dip west as follows :—

Strike 30° E. of S.;	Dip 68° or 70° W.;	100 feet west of vertical.
Strike 36° to 40° E. o5 S.;	Dip 62° W.;	120 feet west of former.
Strike 36° to 38° E. of S.;	Dip 50° to 48° W.,	200 feet west of former.

The strike is inconstant, the rocks having a tortuous course, due to unequal pressure and crowding together of rocks confined. Faults and short breaks occur, slips in the formation due to fracture produced by the strain of upheaval. It will be seen by the following observations made eight miles north of this point, that the dip increases suddenly to the vertical. The height where I observed them was 3,700 feet, 500 feet above the gulch bottom or Granite Creek. The distance here from the eastern margin of the anticlinal was four miles, a recorded dip at this point being:

Strike 25° E. of S.;	Dip 88° E.,	Centre of anticlinal.
Strike 25° E. of S.;	Dip 50° W.;	100 feet west of above.

A number of other strikes and dips were taken which have no particular significance. Through the anticlinal, nearly parallel with the strike and its axis, runs a great vein or a series of veins, on which many locations have been made. It cuts the summit of the mountains at the central portion of the anticlinal, and has been traced for ten or twelve miles. This crack, contrary to what might be expected, widens at the base of the mountains and narrows at the summit, and seems to have been produced not so much by the force of upheaval and lateral pressure as by the later subsidence of the fold, due to the instability of the crust. Had it been an anticlinal crack it would have been wide at the summit and narrowed with depth, but it is the reverse, and probably has been produced as above stated by a pulling apart, produced by subsidence.

The smaller anticlinals and the vertical dip occur about 6,000 feet below the original summit of the anticlinal, the greatest pressure having been exerted here. The veins widen at the base, their width as taken in Snow Shoe Gulch at the summit about 7,000 feet being 2½ to 4 feet, while 1,500 feet below this they measure eight or nine feet in width. The strike of the vein is about 25° east of south, slightly to the east of the centre of the anticlinal. It is filled with quartz, some carbonate of iron with alternating bands of galena, zinc blende and iron pyrites, and may be called a rib banded vein. There are many stringers frequently mineralized, extending out on both sides of the vein in the joint cracks which run nearly at right angles to the bedding planes of the formation, eight miles north of the Snow Shoe Gulch, I examined the vein 3,700 feet above the sea and it exhibited a width of a foot or more. The stringers in the joint cracks on both sides were highly mineralized and in one instance a foot or more in width. This crack or fissure does not extend to as great a height in some portions of the anticlinal as in others. There are other large veins parallel with this both east and west of it but differently mineralized. All the veins carry a small percentage of gold, which accounts for the placer beds formed

at the mouth of the gulch. The veins were probably filled at the time of the fissuring produced at the upheaval, or as I have stated, at the time of a relaxation of the pressure and subsidence of the fold. The slips and faults would seem to indicate this subsidence. The quartz is no doubt the product of the mechanical energy exerted when the rocks were squeezed and upturned. Some of the more interesting facts regarding this anticlinal fold are :—

The great denudation, at least 6,000 feet having been removed from the upper portion of the anticlinal. The removal of this detritus before the glacial period which left its detrital material at the mouths of the gulches, in piles 700 feet in thickness resting on the eroded upturned strata.

The lateral pressure developed producing small anticlinals in the base of the great fold, with fractures and faults.

The relaxation of the strain and final subsidence producing fissures, filled with galenas, etc.

The variation in dip, which seems to assume a rate proportionate to the strain or pressure. The lateral pressure seems to have been applied by a crowding and pushing of the lower portions of the lateral flanks of the strata included in the upheaval.

New Species of Canadian Fungi.

By J. B. Ellis and J. Dearness.

Leptosphæria Lilii.

Spots pallid, thin, oval, with a narrow, slightly raised reddish border, 4 — 10 mm. in the longer diameter. Perithecia conspicuous, epiphyllous but visible from both sides, 150 — 200 μ. Asci oblong-cylindrical, with a short, nodular base, paraphysate, 50 — 60 $\times$ 7 μ. Sporidia biseriate, fusoid, nearly straight, pale yellow (subhyaline at first), 3-septate, constricted at the middle septum, the cell next above swollen, 15 — 18 $\times$ 3 μ.

Accompanied by a phyllosticta:

Phyllosticta Lilii. Ell. & Dear., in similar perithecia, with sporules, pale umber, 4 — 5 × 3 μ. Doubtless the pycnidial stage of the Leptosphæria.

On leaves of *Lilium Superbum*, London, Can., Aug. 1890. (Herb. D. 259).

Phyllosticta Dircæ.

Spots suborbicular, sometimes confluent, subzonate, margin narrow and nearly black, the centre turning cinereous and early falling out, ½ — 1 cm. Perithecia numerous, reddish, scattered over the entire spot, epiphyllous, but visible below, only the apex erumpent, 60 — 100 μ. Sporules oblong-elliptical, hyaline, bi-nucleate, 5 — 8 × 2½ — 3 μ.

On leaves of *Dirca palustris* London, Can., July, 1892, (Herb. D. 1934). This is probably the spermogonial stage of *Sphærella Dircæ* E. & E. *n.s.* found at the same place.

On the same leaves is another (?) Phyllosticta on spots of the same character but smaller and less regular in shape with sporules 8 — 10 × 2 μ.

Phyllosticta Viburni.

Spots amphigenous, rusty-brown, orbicular, about 2 mm., with a narrow dark border. Perithecia epiphyllous, semi-erumpent, black, convex, 100 — 125 μ. Sporules elliptical, brownish, 4 — 5 × 2½ — 3 μ.

On leaves of *Viburnum lentago*, London, Can., July 1892. This differs from all other known phyllostictas on Viburnum in the color of its sporules.

Phyllosticta Chrysanthemi.

Spots orbicular, 1 — 3 mm. purplish-brown, with an obtuse raised border, sometimes confluent and finally deciduous. Perithecia, epiphyllous, black, innate, minute, 80 — 100 μ. Sporules elliptical, obtuse, smoky-hyaline, 4 — 5 × 2½ — 3 μ.

On leaves of *Chrysanthemum Sinense*, London, Can., Aug., 1890. (Herb. D. 260).

Phyllosticta Clematidis.

Spots mostly marginal, then yellowish or withered but when not on the margin whitish, orbicular, 1 — 3 mm. with narrow reddish border. Perithecia brown, epiphyllous, 50 — 75 μ. Sporules ovate-elliptical, hyaline, 4 — 6 × $2\frac{1}{2}$ — 3 μ.

On leaves of *Clematis Viorna* var. *coccinea*, London, Can., Aug., 1892. (Herb. D. 1991).

Phyllosticta punctata.

Spots small, $\frac{1}{2}$ — 1 mm., angular, often confluent, diaphanous, bordered by an obscure reddish line, finally deciduous. Perithecia brownish, epiphyllous but visible from under side, 50 — 100 μ. Sporules amber-colored, elliptic-oblong, 6 — 8 × 3 μ.

Very destructive to the leaves of the guelder-rose or snow-ball (*Viburnum opulus*) on which it is found. London, Can., Aug., 1892. (Herb. D. 1982).

Vermicularia Podophylli.

Perithecia on black, slightly sunken, roundish areas $\frac{1}{2}$ — 3 c.m., conic-hemispherical, 100 — 200 μ, thin, membranaceous, clothed above with spreading black, septate, bristles 100 — 225 × 4 μ. Sporules nucleate, hyaline, lunate, 16 — 23 × 3 — $3\frac{1}{2}$ μ.

On fruit of *Podophyllum peltatum*, Aug., 1892. (Herb. D. 1964).

Cytispora Pruni.

Tubercles seated on the inner bark, raising the outer bark into pustules, apex barely emergent, ellipsoid or conic, opening through white granular substance by a single mouth from a unilocular or incompletely 2 or more celled whitish interior, $\frac{3}{4}$ — $1\frac{1}{2}$ mm. Sporules fusoid-oblong, 2 — 4 nucleate, non-septate, acute at both ends, arising without perceptible basidia from the hyphal nodular lining of the stroma, 12 — 16 × $2\frac{1}{2}$ — 3 μ.

The tubercles are thickly and more or less regularly scattered on dead branches of *Prunus Virginiana*. London,

Can., May, 1892, (Herb. D. 1817). Probably this is the conidial stage of *Cryptospora Pennsylvanica* (B. & C.).

Sphæropsis Viburni.

Spots as in *Phyllosticta Viburni* and on the same leaves, brown, orbicular, distinctly margined with a dark border, 2 — 5 mm. Perithecia amphiphyllous, mostly above, prominent, with a distinct mouth, black, 125 — 200 μ. Sporules oblong-elliptical, dark-brown, 16 — 27 $\times$ 10 — 12 μ.

On leaves of *Viburnum lentago*, London, Can., July, 1892, (Herb. D. 1902).

Septoria Lunariæ.

Perithecia gregarious, dark-colored, innate, slightly erumpent, 55 — 85 μ. Sporules straight or flexuous, linear, hyaline, continuous, 10 — 16 $\times$ 1 μ.

On silicles of *Lunaria biennis*, London, Aug., 1890, (Herb. D. 244).

Glœosporium Saururi.

Spots dark-brown, sub-orbicular, early deciduous, 5 — 15 mm. Acervuli conspicuous, generally along the veins, hypophyllous, pale-brown, 50 — 180 μ. Conidia binucleate, 10 $\times$ 3 μ.

On living leaves of *Saururus cernuus*, London, Can., Aug., 1891, (Herb. D. 843; N. A. F., 2781).

Glœosporium oblongisporum.

Spots suborbicular, pale-brown with a red border, resembling those of *Phyllosticta acericola* C. & E., mottled with minute angular, brown areas bounded by the veinlets, the latter (areas) bear the acervuli which are amphiphyllous but mostly hypophyllous and minute. The discharged conidia spread over the little brown spot and give it when fresh the appearance of bearing a ramularia. Conidia oblong, continuous, 16 — 18 $\times$ 2 μ.

On living leaves of *Acer saccharinum* associated with *Septoria belonidium*, E. &. E., London, Can., Sept., 1891, (Herb. D. 912).

Glœosporium Bowmani.

Spots pale-brown, bordered by a narrow bright red line obscurely zonate, along the edge of the leaf and extending from margin to midrib or indefinitely along the margin. Acervuli epiphyllous, pustulate, concolorous with spot or paler, 90 — 180 μ. Conidia numerous, oblong, hyaline, bi-nucleate 5 — 6 × 1½ — 2 μ.

On leaves of *Epilobium coloratum*, Port Stanley, Ont., (Prof. J. H. Bowman) Aug., 1892, (Herb. D. 2076).

Cylindrosporium longisporum.

Spots pale-brown, orbicular, border brown, 2 — 5 mm. Acervuli small, dark, epiphyllous, 35 — 90 μ. Conidia straight or mostly curved, 8 — 14 septate, 60 — 105 × 3 — 4½ μ.

On leaves of *Lupinus perennis*, July, 1891, London, Can. (Herb. D. 791 , N. A. F., 2784).

Cylindrosporum Chrysanthemi.

Spots large (1 cm. or more), sub-indefinite, nearly black. Acervuli immersed, 100—170 μ diam. Conidia fusoid, nearly straight, 50 — 100 × 3—4½ μ, issuing copiously on both surfaces of the leaf.

On leaves of *Chrysanthemum Sinense*, quickly killing or deforming plants in Greenway's Chrysanthemum houses, London, Can., Nov., 1892, (Herb. D. 2081).

Septoria Chrysanthemi, Cavarra, (Fungi Langobardiæ, 40), has outwardly the same appearance, but it has true perithecia; the sporules are only 35—65 × 1½ — 2 μ and not septate.

Cercospora Pontederiæ.

Spots reddish-brown, indefinite, extending from 1 — 5 cm. or elliptical and more definitely limited 3 — 5 × 2 — 3 mm. and sometimes concave above. Hyphæ epiphyllous, tufted, on a small tubercular base, sub-hyaline, simple, continuous, nearly straight 10 — 15 × 2½ μ. Conidia slender, linear-cylindrical, hyaline, faintly nucleate, 15 — 40 × 2

μ, straight or curved towards the narrow end. Allied to *C. Nymphæacea*, C. & E.

On leaves of *Pontederia cordata.* Niagara-on-the-Lake, Aug., 1891, (Herb. D. 1800).

Cercospora Gerardiæ.

The areas bearing the fungus scarcely perceptible on the upper side of the green leaf, but plainly visible on the under side by the smoky, effused tufts of hyphæ; these areas are irregular, sub-angular, and bounded by the veinlets. Hyphæ tufted, hypophyllous, olivaceous, simple, septate, tapering upward, obtuse and toothed, swollen at base, 25 — 45 × 3 — 7 μ. Conidia slender, sub-olivaceous, faintly 3 — 5 or more-septate, 50 — 112 × 3 — 3½ μ.

On leaves of *Gerardia quercifolia*, Walpole Island, St. Clair River, July, 1892, (Herb. D. 1957).

Macrosporium florigenum.

Effused forming a thin olive-black layer consisting of dark-brown nucleate, septate, prostrate hyphæ sending up sub-fasciculate fertile branches 30 — 100 × 5 μ, subhyaline at the tips, conidia lateral and terminal, clavate, 3 — 5-septate, usually one, occasionally two longitudinal septa, 15— 40 × 12 — 18 μ.

This fungus ran rapidly over the open flowers of China asters in gardens in London, Can., Sept., 1891. A bed of asters in fine flower would within a day or two of the appearance of the fungus have every flower, young and old, darkened and spoiled. One florist, Mr. Gammage, speaking of it, said: "It seemed as though a wind had blown over the asters and blackened them, so quickly was it done." (Herb. D. 1459).

Ramularia Melampyri.

Hyphæ simple, hyaline, 25 — 70 × 3 μ, in tufts arising from an effused nodular mycelium forming a mealy whitish coating on the lower surface of the leaf which becomes curled and deformed. Conidia fusoid-oblong, hyaline, gran-

ular, continuous (*Ovularia, Sacc.*) $10 - 20 \times 4 - 5\ \mu$, very abundant.

On leaves of ***Melampyrum Americanum***, Port Stanley, Ont., Aug., 1892. (Herb. D. 1967).

Botrytis Epichloes.

Hyphæ effused, forming an olivaceous coating on its host, sparingly branched, subgeniculate above, torulose, $25 - 40 \times 2\frac{1}{2} - 3\ \mu$. Conidia lateral and terminal, fusoid-oblong, nucleate, hyaline, $8 - 12 \times 3\ \mu$.

Parasitic on the stroma of *Epichloe typhina*, (Pers.) London, Can., July, 1892, (Herb. D. 1943).

THE HORN FLY.

(*Haematobia serrata, Robineau Desvoidy*).

BY A. F. WINN.

This very troublesome pest has made its first appearance in several parts of Canada, including the Province of Quebec, during the past summer, and I have been asked to give a few notes regarding it in the RECORD OF SCIENCE.

I have only seen the insect in nature in one place, near Boucherville, and have had no opportunity as yet for personal observation. There is little, if anything, still to be learned, however, regarding its life history and habits, as they have been fully worked out by the United States Division of Entomology, and published in their valuable periodical "Insect Life." Our own Department of Agriculture has also recently issued a special Bulletin (No. 14) by the Dominion Entomologist, Mr. Fletcher, on the subject.

The fly, like so many of our other injurious insects, is a European species, having been known there since 1830, and has no doubt been introduced into this country with some imported cattle. The first record of its appearance in large numbers is from Camden, New Jersey, in August, 1887. The next season they spread very considerably, and now extend as far south as Florida, Alabama, Mississippi and

Texas; west to Iowa, Ohio, Kentucky and Kansas; and north through Massachusets and New York into Canada. How much further it will go next summer it is impossible to say, but one thing is certain, and that is, that the farmers of this Province will have plenty of them.

In shape the mature insect is similar to the common house fly, but is only about one third of the size, and of a dark grey color, the body covered with black spines. When settled on the cattle the flies assume two different positions. While at rest on the horns, the wings are almost flat on the back of the abdomen, overlapping one another at the base, and the beak is horizontal; when feeding, the wings are slightly elevated, and held out from the body at an angle of about 60 degrees, and the beak is nearly vertical.

The habit of the flies settling in such masses on the base of the horns, has given rise to many popular errors, the principal one being that the eggs are laid there, and that maggots cause the horn to rot and penetrate through it into the brain. As a matter of fact, the horn is not injured in any way by the flies, and this situation is chosen because they are out of reach of both the head and the tail of the animal. Between the head and foreshoulders they also congregate, but in smaller numbers.

Some breeds of cattle are much more affected than others, by the bites; horses and other animals are not attacked at all. To bite their victims the flies have to work their way down through the hair to the skin, and one would think that the bristles of their bodies would get entangled, but they do not; as soon as the animal gives a stroke of the tail, every fly is on the wing, forming a small cloud about a foot in the air, ready to alight in a moment as soon as the danger is over.

The bites produce great irritation, and sores are often formed by the animals rubbing themselves against trees and fences. If the flies lasted only a few days each season they could do but little harm, but unfortunately the preparatory stages only last about 17 days, and therefore there is a new brood continually appearing to take the place of the former

one, from May till September. The animals, so constantly tormented, fall off very much in weight, and the yield of milk is reduced in some cases to the extent of one-quarter to one-half.

The eggs are deposited singly, between 9 a.m. and 4 p.m. on the surface of the moist dung the moment it is dropped. They are of a brown color .05 of an inch long, from which the minute pure white maggots, or larvae, hatch in less than 24 hours. They immediately descend into the dung a short distance, feeding on the liquid portions, which is their only food. In about a week they are full grown, about .4 of an inch long and of a dirty white color. Entering the ground to become a brown pupae, they remain only about five days in midsummer before the perfect fly makes its appearance, but in the last brood the whole winter is passed as pupae, the flies emerging the following spring.

Of remedies for this pest, there are two distinct classes, one to prevent the flies from biting the cattle, and the other to kill off the insects either in the mature or larval stages. As preventives, almost any greasy substance will keep away the flies for a day or two. Train oil, axle grease, and tallow have all been used with success—the train oil seeming to be the most lasting in its effects.

The flies may be killed by applying kerosene emulsion to the cows with a sponge, or in a large herd by spraying them with a pump. A substance known as " X. O. Dust," made by a Baltimore firm is highly spoken of as an insecticide, and costs about 25 cents a pound, but its effects last only about two days.

The most practical way to combat this insect is to attack the larval stage, immediately after the flies appear in the spring, as every one killed then prevents the existance of a large number later. The maggots can only live in the droppings when moist, and consequently any substance that will absorb the moisture will destroy them. For this purpose lime, plaster, and wood ashes have been recommended, and a shovelful on each dropping would destroy all the larvae. If none of these are at hand dry

earth would absorb sufficient of the moisture to kill most of them, and a still more practical suggestion is that of Prof. J. B. Smith, "By sending a boy over the pasture every other day with a shovel to thoroughly spread out the cow droppings, all eggs and larvae would be destroyed." This would be as effective in wet weather, when the substance would be wasted away, as in dry weather, when it would dry up.

I conclude with a copy of a letter received from Mr. W. A. Oswald, of Belleriviere, Que., in answer to an inquiry of mine regarding the first appearance and habits in his district, which is only some twenty miles from Montreal :—

BELLERIVIERE, Oct. 10th, 1892.

"The Horn fly first made its appearance in this locality about the middle of July, 1892, and from their sudden appearance, and annoying the cattle in such vast numbers, they caused alarm to dairymen, for it was evident that cattle attacked by them failed in flesh, and their yield of milk was much reduced. A noticeable feature was the manner in which it attacked cattle, always settling on the back of the animal immediately behind the shoulder blade, where the heads or tails of the animals could not reach to brush them off. Young cattle, whether from the tenderness of the skin, or the inadequate length of the tail to keep them off seemed to suffer more from their attacks than the older animals. One animal in our herd, a yearling bull was confined to a dark stable for a time, but even there they clung to his sides, until he got a sponging with a weak solution of carbolic acid, or coal oil, which kept them off only a few days unless another sponging was applied. The manner in which they settle around the base of the horns may be compared to the seeds in a sunflower head, so thickly do they congregate, covering the base of the horns completely for two or three inches. Coal tar applied freely to the horns, but not so much as to endanger the animal's eyes keeps them off entirely for a few days. Train oil was applied by some, and pronounced effective in freeing the animals from the flies for a period of five or six days, when it had to be repeated to keep them free from the pest."

TREMATOBOLUS.

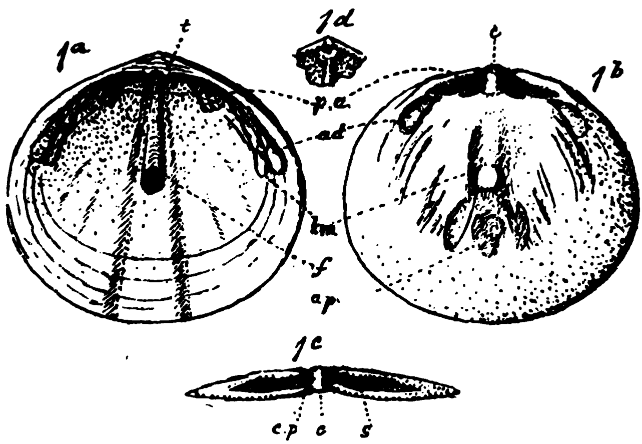
AN ARTICULATE BRACHIOPOD OF THE INARTICULATE ORDER.

By G. F. MATTHEW, M.A., F.R.S.C.

A remarkable shell has come to light in working over the material from Band *b* of Division 1 of the St. John Group, which seems worthy of special notice.

TREMATOBOLUS, n. gen.[1]

TREMATOBOLUS INSIGNIS. Fig. 1 *a* to *d*.



1. *Trematobolus insignis.* Mag. $\frac{4}{1}$—1*a*. Ventral valve—1*b*. Dorsal valve—1*c*. Back view of hinge line of dorsal valve—1*d*. inside of beak of ventral valve (beneath the hinge area.)

Notation of the muscles, &c.—*p.a.* Posterior adductors—*a.d.* Adjustor muscles—*l.m.* Lateral muscles—*a.p.* Anterior depression—*c.p.* Cardinal pits—*c.* Cardinal process—*s.* Hinge socket—*t.* Dentiform process of the ventral valve—*f.* Foramen.

Shell a meniscus, inequi-valve, articulate. Valves thin, closely applied. Shell substance calcareo-corneous ?

Dorsal valve, oblate, concave. At the hinge is a long narrow socket, at right angles to the plane of the valve, fitted to receive the anterior edge of the area of the ventral valve. The socket is interrupted in the middle by a cardinal process; this process extends into the interior of the

[1] Name from *trema* and *obolos.*

valve, and is flanked on each side by a small, deep pit. At the back of the shell on each side of the cardinal process is a dental plate and in front of it two transverse, lobed, triangular depressions, supposed to be due to the posterior adductor (cardinal ?) muscles. On each side of the shell adjoining these depressions are the scars of the adjustor muscles. There is a broad shallow groove along the median line of the valve which would mark the place of the anterior adductor muscles ; this depression is divided lengthwise by a low ridge, and forks at the middle of the valve into two arched branches, which include between them a shorter depression ; the arched branches, would perhaps be the scars of the lateral adjustors. There are several faint raised vascular lines (about four on each side of the median line of the valve) ; of these lines the outer are more arched than the inner, and all radiate toward the margin of the valve.[1]

The ventral valve is moderately convex and oblately orbicular, with a short blunt umbo; and has two, low gradually diverging ridges marking off a narrow, triangular, median area. There is a low, striated hinge area, the front edge of which is slightly toothed, to fit the small pits on each side of the cardinal process of the dorsal valve. The interior of the ventral valve has a prominent ridge extending from beneath the area, half way to the front of the valve; this ridge arises from the indentation of the back of the valve by the pedicle groove ; the surface of the ridge is seamed transversely by arched ridgelets, which marked the changing position of the foramen of the pedicle, as the shell grew ; the ridge does not quite reach the umbo but is separated from it by a small, low boss, having a central depression, or umbilicus. In the ventral valve the position of the posterior adductors is marked by a pair of triangular scars, beginning under the outer part of the hinge. Each scar shows the points of attachment of three muscular bands. The scars of the ad-

[1] The boss at the centre of this valve appears to be the clay plug of the foramen of the ventral valve, cemented to the dorsal valve.

justor muscles, and of the lateral (anterior adductor?) muscles, run parallel to each other along the sides of the valve, from near the hinge line; and they extend further forward than do the scars of the adjustors of the dorsal valve.

Sculpture—As we have only the interior of this shell the surface markings of the outside are scarcely discernible; towards the front of the valve, however, they become visible under the lens, and are seen to consist of fine concentric ridges; and very fine, broken, radiating striæ, visible only in a few places.

Size—Length of the dorsal valve 8 mm., width 10 mm. The ventral valve is 1 mm., longer than the dorsal.

Horizon and *Locality*—Found by W. D. Matthew in the upper part of the second assise of Band *b* in Division 1, (1 *b*. 2") of the St. John Group at Hanford Brook, St. Martin's, N.B., Canada.

This remarkable brachiopod is a synthetic form, showing affinities in several directions; it is thus connected chiefly with the Obolidæ, but differs from all in the articulate connection of the valves. The arrangement of the muscles is similar to that in Obolus and Obelella, but as regards the ventral valve is modified in the direction of Siphonotreta. The position of the pedicle corresponds almost exactly with that of *Schizambon* (?) *fissus* var. *Canadensis* Hall, of the Utica Slate,[1] but in our species the interior of the beak exhibits a peculiarity, which may indicate a habit in the young shell (or in an ancestral form of the species) different from that of the adult; this peculiarity is the existence of a small boss or callus in the umbo, which, having a central umbilicus, appears to be homologous with the boss and foramen in the umbo of such shells as Acrotreta and Linnarssonia.[2] Evidently the pedicle did not go out at this point in the adult shell, but the umbilicus may indicate that it did at an early stage of growth. According to Kutoraga[3]

[1] See Genera of Palæozoic Brachiopods, Hall & Clarke, Pl. IV, fig. 33.
[2] Op. Cit. Pl. III, figs. 35, 38 and 39.
[3] Op. Cit. Pl. IV, figs. 22 and 23.

Siphonotreta had a mammiform swelling around the tube in the umbo.

The nature of the hinge connection too, is very remarkable, and implies a mechanism similar to that of the articulate brachiopods. Compare for instance the dorsal valve of *Orthis strophomenoides*, Hall,[1] (or *O. testudinaria*, Dal.[2]) with its central ridge and cardinal process, with that of Trematobolus; in the Orthis, the sockets of the dorsal valve afford a rest similar to that furnished by the elongated hinge pit of the corresponding valve of the former genus; in the Orthis, however, the socket is in the inner face of the valve and met the tooth only of the opposite valve, whereas in our genus the whole base of the dorsal is applied to the ventral.

The genus Barroisiella of the Genessee shale shows a mechanism at the hinge somewhat similar to that of Trematobolus, in the bosses on each side of the pedicle groove of the ventral valve,[3] but no such cardinal process is figured on the dorsal valve as that which exists in the latter genus.

In the form of the median muscular imprint of the dorsal valve Trematobolus will be seen to resemble the corresponding sculpture of the dorsal valve in Obolus, as figured by Kutoraga.[4] In both genera this depression breaks up at the centre of the valve, into three scars of which the two outer ones arch around the middle one.

This genus differs from Obolus and Obolella in its perforated ventral valve; from Siphonotreta in the perforation being in front of the beak, and in the absence of the sipho; from Schizambon in its articulate valves, and in the arrangement of the muscles of the ventral valve; and from all these in its concave dorsal valve. From Michwitzia, which also has a concave dorsal valve, in its perforated ventral valve.

In general Trematobolus may be looked upon as combining the features of Siphonotreta, Schizambon and Obolus in its ventral valve with those of Obolus, Obolella and Orthis in its dorsal valve.

[1] Op. Cit. Pl. V, fig. 26. [2] Op. Cit. Pl. VB, fig. 39.

[3] Op. Cit. page 80, fig. 34.

[4] Op. Cit. Pl. II, fig. 14 and 15. The hinge of the dorsal valve, fig. 16, (copied from Meek & Worthen) evidently does not fit the cardinal line of the ventral valve.

THE COLOURS OF FLOWERS IN RELATION TO TIME OF FLOWERING.

BY A. T. DRUMMOND.

A new interest has, during recent years, been given to the study of plant life by the researches of Wallace, Darwin, Lubbock, Grant Allen and others. We had been led to think, and it seemed a natural conclusion, that the fragrant odours, the brilliant colours, the varied forms and the distinctive habits of flowers were all intended for the pleasure and education of man. There had been the suggestion that these characteristics had their part in the economy of the plant itself, but this suggestion had not attracted much attention. Now we find that in at least a very large number of plants, the beautiful tints and curious shapes of the petals and sepals, the honey which flowers secrete, and the odours, fragrant or offensive, which they give out, all play their part in the processes of reproduction, by attracting to them insects which unconsciously, in their turn, carry the pollen from one flower to another, and thus perfect fertilization. Whilst the colour, the scent, the honey or pollen form the objects of the insect's visits, the plant has in turn, in process of long time, adapted itself in habit and in the brilliancy of hue and in the shape of its flowers to attract the insect, and cause it to carry the pollen from flower to flower and plant to plant.

The question of colour in connection with plant life has, however, a further interest, to which I desire in this paper to refer. Among flowers, different colours preponderate during different months of the year, and this will be found to be true, not merely of the great masses of flowers taken as they appear, month by month, without reference to species, but also in relation to the species themselves. Everyone who has collected flowers must have observed that whilst in the spring white is the predominating hue, and in August yellow prevails, the month of September is characterized in our latitude by the preponderance of tints of blue and purple. Sometimes a few species will, through

the great abundance of the individuals of each, or the size of their flowers, give to a locality the preponderating colour. Thus, in early spring, the Blood root and the Trillium, in patches here and there, mottle the ground with white, whilst in August and September the Golden Rods and the Asters give the yellows and blues of the foreground of our landscapes. The subject is one of some interest, and I have recently attempted, in a general way, to ascertain what proportion, in our northern temperate latitude, one colour bears to another, month by month, taking, not the general mass of the individuals of each species, for that would be difficult over any wide area, but the number of species having one colour in contrast with the number having another.

In making this attempt I have taken into account, as far as variations and differences of locality would allow of comparisons being made, the colours and times of flowering of 539 of the plants of Ontario and Quebec. The most striking feature at once observable is the preponderance of white flowers, which form rather more than one-third of the whole. Following somewhat closely upon them, the Composites contributing largely, are the yellow flowers, which include about one-fourth, whilst the purples and blues are much less numerous, and comprise about one-ninth and one-tenth respectively of the whole. We have long known that a considerable proportion of the Arctic plants have white blooms, and a preponderance of this colour appears to be continued into northern temperate latitudes as well.

It has been suggested that the flowers which have undergone least modification are usually yellow or white, or in other words, that these are more or less original colours among flowers, a higher development leading to pink, red, purple and blue. Grant Allen has gone further in considering that "all flowers, it would seem, were, in their earliest form, yellow; then some of them became white, after that a few of them grew to be red or purple, and, finally, a comparatively small number acquired various shades of

lilac, mauve, violet or blue." This is a very broad assertion, needing, probably, more careful enquiry, and that over the widest possible area. Judging from the flora of North Eastern America alone, I should have been inclined to regard white as the earliest, as it is, in our latitude, a preponderating colour among flowers. There is an intimate association between light and the development of colour among plants. Where light plays a less important part, as among night flowers, the tints of the petals are white, as if that were the starting colour. The colours of the spectrum, separately, and blended into one as white, are, besides, the colours we meet with among flowers. Again, variation in colour in the same species is a well-known feature among some of our American forms, but this variation is, as a rule, from purple, blue or rose to white, or the reverse. Thus *Viola cucullata* shades from purple and blue to white, and some of the Asters and species of Mimulus, Veronica, Hepatica and others have as wide a range. Should this variation be regarded as, in any sense, progression or degeneration, the tendency would be from or to the original color, and it is but rarely with us that the tendency is to or from yellow. The little Bluets are said to sometimes produce even white flowers with a yellow eye, *Oxytropis Campestris* to have yellowish or white flowers, and *Anemone Multifida* to vary in colour from red to greenish yellow and white. We have also a few cream-coloured flowers, but it is, perhaps, more easy to predicate of these that they have sprung from a white than a yellow ancestor.

If we consider the relative ages of the species comprising the flora of North Eastern America so far as there are data on which to found an opinion, we find that *Viburnum pubescens*, which occurs in the Eocene, has white blossoms, that *Magnolia glauca* found in the Pliocene, has also white flowers, that a very large proportion of the plants common to Europe and America—the remains of one of our older floras—has also white flowers, whilst the newer creations, like the Composites—an order of no great antiquity—have a large proportion bearing yellow flowers. The whole

question of priority of colour is one for speculation rather than one susceptible of proof.

In considering the colours prevailing during the different months, it must be remembered that in time of flowering and in, probably, the length of continuance in bloom, a species in the Ontario peninsula bordering Lake Erie will differ from the same species in the neighbourhood of Montreal or Quebec. Thus, the spring flowers which may be collected during the first and second weeks of April in the vicinity of London, Ontario, are not found in bloom around Montreal until about two or three weeks later. Again, species occur in the Ontario peninsula which are not found to the eastward of it. The conclusions drawn must therefore be, in a sense, general.

The following is, then, approximately, the distribution of the 539 species before referred to, throughout the summer months, according to colour, a species continuing in flower into another month, appearing in that month's column as well, in order to show the prevalence of colour for that month.

	April.	May.	June.	July.	Aug.	Sept.	Oct.
White..............	16	73	82	79	50	23	12
Yellow............	8	23	34	49	73	52	2
Blue...............	..	14	14	17	16	21	17
Violet and Purple.	6	14	25	33	22	27	14
Green, and shades of it............	6	13	17	14	7	3	1
Rose, Pink and Red............	..	11	8	8	6	3	..

April, May and even June and July are thus remarkable for the prevalence of white, July and especially August of yellow, and September and October of purple and blue.

It is suggestive that the appearance of white as the predominating colour in early spring has its explanation, in part, in the absence of bees and other insects which commence their search for honey later on, and prefer the more

highly colored flowers. Where the process of fertilization depends on the aid of certain insects, there would be no reason why these plants should burst into bloom before these insects appeared. Opportuneness is characteristic of the operations of nature. When bees, wasps, butterflies, moths and flies abound, the plants which they more especially frequent will be found presenting their flowers in all their attractiveness, and ready to engage the attention of these insects. And there is design in all this, for, as Sir John Lubbock says, "just as our gardeners, by selecting seed from the most beautiful varieties, have done so much to adorn our gardens, so have insects, by fertilizing the largest and most brilliant flowers, contributed unconsciously, but not less effectually, to the beauty of our woods and fields."

NOTES ON AN OLD INDIAN ENCAMPMENT.

By Prof. W. L. GOODWIN. D., Sc.

Cape Tormentine is the general name for a group of headlands forming the part of New Brunswick nearest to Prince Edward Island. On Jourmain Island, now joined to the mainland by salt marsh, is Money Point, the one of these headlands selected as the point of departure for the proposed tunnel to connect New Brunswick with Prince Edward Island. The coast in this neighborhood seems to have been a favorite camping ground for the Micmacs. Stone implements of all sorts are found in considerable numbers. Five or six very good axes were found last summer. Arrow-heads are, I believe, not often found. The axes and other cutting and scraping implements are made of diorite, boulders of which are quite common along the shores of Cape Tormentine, although rather rare inland. The red Permian sandstone is here rather soft, and yields rapidly to the action of salt water. The shores are thus undermined, and the overlying boulder clay is brought down. The diorite boulders are thus strewn along the shore, intermingled with slabs and rounded fragments of sandstone, granite boulders, etc. From the number of half-

finished implements found, it would seem that the aborigines visited this place for the purpose of manufacturing. There is to be seen on the shore of Jourmain Island a large diorite boulder, weighing several tons, which has evidently served as a source of material. It is easy to see that pieces have been split off. The upper surface is quite rough and new as compared with less accessible parts. The operation of splitting must have been very difficult with the means at the disposal of the Indians. This diorite takes a beautiful polish, which brings out the colours of the feldspar and the hornblende which compose it. It is quite evident, however, that the fashioners of these stone implements were a very inferior race. Their workmanship is of the rudest. Perhaps the comparative scarcity of arrow-heads has some significance in this respect. A beautifully wrought arrow-head of milky quartz was found last September quite near the surface in Baie Verte (about 20 miles westerly from Cape Tormentine). This, however, I imagine to belong to a later age. In a cove between Money Point and the bluff headland upon which Cape Tormentine light stands is to be found the camp-ground of these rude savages. The washing away of the shore has exposed a vertical section of a shell-midden, and, not far away, of a fire-place. These are about 18 inches below the present surface. The shells are mostly those of the edible mussel (Mytilus edulis), with a few large whelks (Lucata heros ?) These shell-fish are still very plentiful along the shores. The site of the fire-place is marked by ashes, small pieces of charcoal, and "burned" stones.

Here in this quiet cove, sheltered from the north winds by the highland of Money Point, at a place where the land sloped gently down towards the sea, and the sandy beach free from rocks offered a safe landing place for their canoes, the savages built their wigwams, replenished their stock of implements, and meanwhile lived upon mussel and whelks, with perhaps an occasional striped bass; although these vigorous fish would in all likelihood be too strong for their imperfect lines and hooks.

A Visit to Lake Superior Mines.

By W. A. Carlyle, Ma. E. McGill University.

The following pages cannot be consistently classed as pertaining to purely scientific matters, describing, as they do, a few weeks spent with much profit and interest among those celebrated mines of Lake Superior, in visiting the most noted mines, observing the many details of work and collecting data as to the geology of the deposits, the ores, the mining work and machinery, data of more especial interest to an engineer. However, as the ultimate destiny of scientific work is its practical application to the affairs of man, these pages of practical observations may prove of some interest.

During the early part of the summer last past, impelled by an eager desire to see and enjoy the long-heard of and bepraised beauties and natural charms of the great Upper Lakes, but primarily incited thither by accounts of the iron and copper mines on the American side of Lake Superior, we left Detroit on an American steamer for the northern waters. The night was dark with a drizzling rain, still the scene was fine as we steamed up the river into the darkness. The lofty electric light towers gemmed the black clouds while the lower city lights and those of the many craft on the river, of the rapid, brilliantly illuminated ferry boats and the more sombre freight steamers, plying unceasingly through the dark waters, made such a pretty sight that, despite the rain, we watched from the deck the glittering picture of myriad flashing, scintillating lights, rapidly drawing astern.

Few in Canada, attracted by commercial interests, are aware to what gigantic proportions has grown the American shipping trade on these lakes. To state that during the seven months of open water a greater tonnage passes by the port of Detroit than the combined annual tonnage of London and Liverpool, is to provoke an incredulous smile, often not politely concealed; yet we have from official reports that in 1889, 36,203,000 tons passed this

port, while the total tonnage of the port of London was 19,245,000 and that of Liverpool 14,175,000 tons, or an excess in favor of Detroit of 3,000,000 tons above the combined shipping of the two great English shipping ports, and a corresponding excess has been maintained during the ensuing years.

Of this great traffic we became conscious as our steamer followed the direct route northward through Lake Huron. Day and night we had ever in sight an unending succession of large vessels heavily laden with ore, grain, flour, lumber, bound down the lake from the ports on Lakes Michigan and Superior, the collecting centres of much of the produce of the great West; or of vessels returning with cargoes of coal, coke, iron and merchandise. In fact a vessel is passed every seven minutes on the average, bound the opposite way. To one not prepared this journey is a revelation. The vessels mostly used in this vast carrying trade are distinctly peculiar to these waters, and, known as "steam barges," are screw steamships of large capacity, built of iron and steel, and equipped with the finest naval machinery, capable of maintaining a speed of 14 to 15 miles per hour with a burden of 2,000-3,000 tons of freight. Many of these steamships, apart from their own cargoes, have in tow two or three convoys or large iron vessels without machinery. Thus day after day during the shipping season does this vast fleet of ever increasing numbers, ply over these great waterways, carrying to and fro, of the commodities from the granaries, mills and mines of the nation to our south.

Off to the east could be seen surrounded by strong triple booms, enormous rafts of logs towed by large steam-vessels, bound from our Canadian forests to the mills on its American shores, a reciprocal reduction of duty on timber between these two countries having speedily engendered a great advance in that industry during the past year. Passing Presquile Point this great highway of the lakes divides and many vessels comprising the shipping to and from Lake Michigan and carrying the great tonnage from Es-

canaba, Milwaukee and Chicago take the route to the west into this lake.

We pursued our northward course until we entered the narrow and tortuous channels leading to St. Mary's river, the connecting link with Lake Superior. With slackened speed our steamer carefully threaded the difficult passages and the whistle kept booming out the signals of "port" or "starboard," signalling to the vessels coming down on what side to pass.

Through this part the scenery is beautiful and interesting, but our attention was suddenly all-absorbed when our steamer, sweeping around a point, headed for the Port of Sault Ste. Marie, towards a veritable forest of masts rising near the fleecy foam-tossed Falls, or the Sault, that marks the place where men, undaunted and determined, to sail their vessels up into the Great Father of Waters, have built the great canal locks, the largest in the world.

The Canadian town at the Sault is very quiet and unassuming, with some large hotels, but little used, and pretty residences. But little shipping enters this port, not even the large steamships of the C. P. R., nor will they until the completion of the Canadian locks and the deepening of the harbor. At the American Sault a large number of vessels is always awaiting above and below the lock for their turn of passage, and daily from 60 to 84 are locked through. Hard by a second lock is being built by the United States Government which will be 800 feet in length, 100 in width and 21 feet on the mitre sills, and costing $4,800,000, while the present lock is 515 feet long, 80 wide and 17 feet deep on the mitre sills, permitting four vessels of the largest size to be locked through at once in the short time of twenty minutes if all goes well. The Canadian lock of nearly the same dimensions as the American new one, and to cost $5,000,000, is being hurried to completion with all speed, when Canada will have from Port Arthur to the Atlantic perfectly independent waterways, while the United States will, perforce, be compelled to use our channels at

Niagara and the St. Lawrence but most notably the Lime Kiln Crossing near Detroit.

At present Canada's share in this vast lake commerce is comparatively insignificant, but we hope that she will yet be in a position to compete for and win a more goodly share and to utilize her many fine harbors, fitted up at great expense but now almost deserted and unused. Much of the commerce rightly hers has been lured away and is being carried in American ships of better and speedier construction, while our own lake fleet languishes and grows yearly smaller. In 1880 there passed through the Sault Ste. Marie canal 1,734,800 tons valued at $29,000,000, while in 1890, 10,557 vessels gave 9,041,000 tons of cargo valued at $102,214,000, or a tonnage nearly doubling that of all nations passing through the Suez canal. It may be of interest to note the chief constituents of this great traffic:—Coal, 2,177,000 tons; flour, 3,239,000 bbls.; wheat, 16,217,-000 bushels (in 1891, 38,816,000 bushels; copper, 43,729 tons; iron ore, 4,774,000 tons; lumber, 361,929,000 feet B. M.

At Marquette, the prettiest town on Lake Superior, we disembarked. This port, with its excellent harbor is, with Escanaba, the great outlet to the lakes for the iron ore from the mineral ranges inland. There are three gigantic ore docks, with a capacity of several hundred thousands of tons, double-tracked on top on which run the trains from the mines with 600-1000 tons of ore each, discharging into large pockets that in turn can be very rapidly discharged into the vessels, so rapidly in fact, that under very favorable conditions, a vessel has been loaded with 3,000 tons of ore in one hour and forty minutes.

Going inland about twenty miles we visited Ishpeming and Negaunee, two towns three miles apart of 16,000 population each, the centre of one of these great iron regions. The country round about is very rough and rocky and in the valleys are situated the mines. The rocks belong to the oldest of geological formation, and the country, rugged and irregular, with ridges of gneiss and the stratified for-

mation of the Huronian, with great eruptive masses of greenstone or diorite, exposing on their flanks outcrops of steeply inclined beds of "lean ore" or very ferruginous jasper-rock, or even of the best iron ore, tells of great dynamic influences that rent and twisted and up-turned the earth's floor after the deposition of the great beds of iron oxide.

The ore of this district is all hæmatite of 55-66 per cent. iron and it is found and known as "hard," "soft" and "specular" iron ore. The "soft" ore seems to be the result of the decomposition of strata containing a high per centage of iron, and is so soft that in many mines it can be mined with pick and shovel alone, using but little dynamite, but necessitating a very strong system of timbering. In some properties with very thick deposits the ore has been worked out by beginning at the top, and mining away a thickness of about eight feet, allowing the roof to fall in after the floor had been covered with slabs. When the roof had come down, another thickness of ore was removed, the shabs on the timber keeping the rocks of the broken roof from inter-mingling with the ore, in this manner enabling the company to mine a deposit from 60 to 80 feet thick without entailing much expense for timbering. In some cases the specular iron is extremely hard to drill, being very much harder in such cases than quartz or granite. The ore is always classed as Bessimer or Non-Bessimer, according as it analyses low or high in phosphorus, and the Bessimer commands about 50 cents more per ton, so that in mines having both classes of iron some superintendents have materially increased annual returns by mixing ore high in phosphorous with ore very low up to the limit allowable in Bessimer ore.

These Michigan iron ores so far are found only in rocks of the Huronian Series, consisting of quartzites, schists, banded jaspers, limestones and diorites. There are two distinct, and nearly parallel, groups about 40 miles apart, the Marquette and Menominee, though of recent years two other ranges, the Vermillion and Gogebec, have come into

great prominence. In mining the ore is found in very irregular forms, seldom disturbed by faults of any considerable throw, and often in masses or lenses of great thickness and area, producing immense quantities of the best ore but little intermixed with waste rock. This is of great importance as prices have fallen so low that ores not assaying at least 56% iron are barely remunerative enough to mine. On examining the many large stockpiles of ore broken during the winter, one sees that the ore is nearly perfectly pure, and at some mines it is difficult to find any waste material whatever in these piles, so large are the beds of clear hæmatite, and so skilfully and carefully do the miners extract and sort the ore.

Some of the largest properties are now owned and operated by large companies that have most extensive smelting works in Ohio and Pennsylvania, near the market for iron and within a short distance of the sources of coal or coke. The companies have erected superb mining plants, have reduced the cost of mining to a minimum, and by using their own fleets of steamers, have so cheapened the ore, that now at Cleveland or Ashtabula on Lake Erie, ore when delivered at these ports is worth only from $3.50 to $5.50 per ton. At latest quotations Bessimer pig iron is worth $15.25 per ton and grey forge iron $13.50. During the season now closed it has been computed that from this iron region of Lake Superior, 9,000,000 tons have been shipped, and that during the season of 1892, 13,000,000 tons will be sent to the smelters. Keeping in mind this enormous production from Michigan alone and the very low prices, one can readily see that it will be a long time yet before our extensive Canadian iron deposits can be mined with profit, and our own production of pig iron will be limited to that amount of charcoal iron as will supply our home market.

The copper mining of Lake Superior has been mostly confined to that peninsula of Northern Michigan terminated on the North by Keweenaw Point, and known as the Portage Lake District. The geological history of this area

has proved a very puzzling study, but the copper ores are found in the rocks of the Huronian age. The older mines, such as the Quincy, Franklin, Atlantic, are working in an Amygdaloid rock, in which great masses of pure copper, so difficult to mine, have been found. Our time, however, was spent mostly at the Calumet and Hecla, the greatest copper mine in the world.

This great mine along with the Osceola, Alluez and Tamarack, is working in a conglomerate containing much felsite and quartz, that has a dip of 38° from the horizontal, and maintains a nearly uniform thickness of eight feet of ore averaging 5% of copper. In the early history of the Calumet and Hecla we read of the long and hard struggle of the men who first realized the great possibilities of this copper-bearing conglomerate, men who, with very limited means, not only spent all the money they could gather, but also labored themselves in the mine amidst many hardships and discouragements. Two of the leaders, or in fact, the two leaders, were Agassiz, a son of the eminent scientist, and a relative, and these two now are enjoying the great wealth this mine is pouring into their coffers.

This mining property embraces the out-crop of the deposit, and along this out-crop the company has thirteen inclined shafts down through the ore body, some over 6,000 feet in length. In the power-houses one sees the finest mining machinery in the world. From each, three or four shafts are operated, the cable drums being driven by one engine. In the chief station is a magnifient engine of 4,700 horse power and costing nearly one half million of dollars, which hoists 5 tons of ore at a time in four shafts besides supplying compressed air for many machine drills. One is simply amazed at the vast assemblage of powerful engines of the finest design, and all in duplicate so that if one breaks down another in a few minutes is doing its work. This summer from 2,500 to 3,000 tons of ore were being mined daily, the ore on reaching the head of the shafts, being run through rock breakers thence into railroad cars which were taken four miles, descending 700 feet, to the concen-

trating mills at Lake Linden, a lake supplying, besides all water, a direct connection with Lake Superior.

These mills are very large, one being the largest frame building under one roof in the world. The locomotive runs the loaded cars in at the top of the building where the ore is shot down into large ore-bins whence it is fed into the large improved steam stamps, each of which is crushing in 24 hours, the large amount of 235 to 250 tons of ore fine enough to pass screens of $\frac{3}{16}$ inch aperture. From these stamps the ore passes first into hydraulic classifiers, where all the coarse copper is collected, thence on to the Collum's jigs with 56 screens per stamp, while the fine slimes pass onto the slime-tables to receive the final washing.

In all these mills a great volume of water is required, and in the pump houses there was one set of pumps with a daily capacity of 50,000,000 gallons, but at the time of our visit a magnificent triple expansion pump, designed by Mr. Leavitt of Boston, with a daily capacity of 60,000,000, was pumping to an elevation of 50 feet, 44,000,000 gallons a day, or about three times the amount of water used daily in Montreal. To get rid again of this immense amount of water and waste rock from the mills, two sand wheels, 50 feet in diameter, and capable of daily lifting 30,000,000 gallons of water and 3,000 tons of sand, lift these tailings 50 feet into flumes that discharge far out into the lake.

Situated about two miles away on the lake shore, are the smelting works where the concentrated copper from the mills is smelted and run into ingots, although a large part is smelted at the company's works near Buffalo.

Visiting some of the other mines, though none in equipment or output can compare with this great mine, we found them working at the Tamarack mine at a depth of over 3,300 feet, while another shaft was down over 4,000 feet, propably the deepest shaft in the world. Looking over the mining returns of this famous peninsula, we learn that up to 1890, 65 mines had produced 1,327,799,420 lbs. of copper, valued at $243,706,809. In 1891 the yield of copper in the

United States was 43% of the world's production, or as follows :—

United States............	292,620,000 lbs
Montana....................	113,200,000 "
Lake Superior Region...	109,370,000 "
Calumet and Hecla........	65,000,000 "

In 1893, it is expected that this great mine that has now paid over $35,000,000 in dividends, will produce 90,000,000 lbs. of copper, and it is now so prepared that should copper fall from its present price of 11·7 cts. per lb. to 6 cts., a good profit will still be made.

In a rapid journey along the Canadian side of the Lakes, we learned that little or no mining was being done, the mines near Port Arthur that had been busy having been closed down for various reasons. Passing down between Manitoulin Island and the mainland we saw the mills and smelter of the once well-known Bruce mines falling into decay. But some day, we believe, in this part of Ontario, there will be opened up and vigorously developed valuable ore bodies now lying untouched or unknown.

Changes in the Flora of Montreal Island.

By Robert Campbell, D.D., M.A.

Dr. Holmes' catalogue of the grasses and carices prevailing in the vicinity of Montreal seventy years ago was never published, and so the only means we have of comparing those two classes of plants, as they were represented then and now in this district, are in keeping of the authorities of McGill College, in whose museum the Holmes Collection is preserved. His Herbarium did not embrace the Musci and Hepaticæ of the neighborhood; and so for the present our remarks extend not beyond the more popular flora—well-known phænogamous plants.

As might be expected, the chief changes that have taken place have been owing to the introduction of foreign summer plants. A few spring flowers are now found which

Dr. Holmes did not mention; but some of these must have been accidentally omitted from his list, as they always probably grew in our forests. *Caulophyllum thalictroides* for instance, one can scarcely doubt, is a native of the district, as it is found widely diffused throughout both Ontario and Quebec. The same thing is true of *Elodes Virginica, Prunus Americana, Fragaria Vesca, Rubus hispidus, Ribes hirtellum* and *Aster Acuminatus* among others. The cutting down of woods, the clearing of swamps, and the drainage of marshes have no doubt greatly circumscribed the growth of our wild flowers, especially those that gladdened the eyes of the early settlers in this country, coming in with the first heat of spring. But I think it likely that no plant that ever flourished in the district has become entirely extinct with the progress of agriculture. There are still typical swamps and marshes and clumps of wood on the island affording the peculiar soil and protection which each native plant requires; and, although collectors, non-scientific more than scientific ones, have not spared some of the rarer and more showy plants, yet I believe that a patient search will be rewarded with finding specimens still in unfrequented spots of every species that ever characterized the island. Some mentioned by Dr. Holmes are now rare. I have not found them, but I do not despair of coming across them in due time. The following, for instance, Dr. Holmes credits the district with producing: *Ranunculus Purshii, Brasenia peltata, Nymphæa odorata, Sarracenia purpurea. Mollugo verticillata, Rhamnus alnifolius, Lathyrus palustris, Apios tuberosa, Dalibarda repens, Lythrum verticillatum, Lobelia Kalmii, Oxycoccus palustris, Chiogenes hispidula, Andromeda polifolia, Kalmia glauca, Ledum palustre, Rhodora Canadensis, Lysimachia ciliata, Utricularia vulgaris, Epiphegus Americana, Gentiana Saponaria, Menyanthes trifoliata, Asclepias incarnata, Dirca palustris, Cypripedium Spectabile, Symplocarpus fœtidus, Lemna polyrrhiza, Potamogeton lucens,* do. *natans,* do. *perfoliatus, Pontederia cordata,* and many orchids. If we have lost any species at all, it is probable that it is among the plants that demand seclusion and moisture,

chiefly those that come early in the season. But several plants that used to be easily found on or near Mt. Royal are now rare, amomg them *Podophyllum peltatum*, *Dicentra Canadensis*, *Geranium Carolinianum*, *Staphylea trifolia*, *Chrysoplenium Americanum*, *Triosteum perfoliatum*, *Antennaria Margaritacea*, *Chimaphila umbellata*, *Lilium Philadelphicum*, and a good many ferns. The clearing away of the underwood by our Park and Cemetery Commissioners, and the Gothic habits of the people visiting our noble park and beautiful cemetery in carrying away armfuls of the wild flowers, must be held responsible for the gradual disappearance of many species that used to adorn those popular resorts. *Solanum nigrum*, *Gerardia purpurea*, *Datura Stramonium*, *Sambucus ebulus*, *Celtis occidentalis*, and *Daphne Mezereum*, all grow on the island, but are not every day met with.

On the whole, however, it is clear that we have gained more than we have lost by the progress of civilization, and the advance of soil cultivation. The gain is due mainly to the introduction of foreign grains and flowers and grasses. New varieties of wheat, barley, oats, turnips, beets, clover, timothy, &c., have been imported, and in spite of all care the seed of other plants has come in with them. In this way we have received an immense addition, especially to our summer flora—those plants which in their native country were contemporaneous with the grain and other seed which we have brought from abroad. The mustard family have won an unfortunate eminence in this respect, proving an increasing nuisance to our farmers. *Lepidium intermedium*, *Senecio Jacobœa*, *Erigeron bellidifolium*, *Rudbeckia hirta*, *Cichorium intybus*, *Sonchus Asper*, *Tragopogon pratensis*, *Leucanthemum vulgare*, *Nepeta glechoma*, *Lithospermum hirtum*, many *Asters* and *Solidagos*, *Silene cucubalus*, *Silene Pennsylvanica*, several varieties of *Ranunculus*, *Trifolium agrarium*, *Medicago lupulina*, *Melilotus officinalis* and *Melilotus alba* and several *Euphorbias* are among the most prominent of the plants thus introduced since the Holmes collection was made.

REPORT OF MR. R. W. MCLACHLAN, DELEGATE TO THE ROYAL SOCIETY.

Notwithstanding that delegates representing affiliated societies, at the meetings of the Royal Society, are only expected to read reports from their respective societies and then participate in all further proceedings as mute listeners, by coming in contact with our most renowned scientists and men of letters, they cannot but become imbued with a deeper love of these higher pursuits. It was a happy thought to give the different literary and scientific societies of Canada a voice in this annual congress of scientific men. This voice should be untrammelled by any disabilities. Thus those less advanced lay brethren in the paths of science may each year go home with more heart for scientific research, and with a greater measure of ambition to delve after hidden truths and bring such truths to light. And they communicating this spirit, if not the ambition, to their fellow workers in local scientific circles, begin to grow apace. With this band of union, the local bands, more closely drawn together, may go cheerily on to greater results in the future pursuit of science through the whole Dominion.

As unfortunately our President, who was first chosen, found it impossible to represent us, the duty devolved at the last moment on your Secretary. His report referred to the continued success of the RECORD OF SCIENCE, and to the work done by the Society in the shape of a list of papers read, and the Somerville lectures delivered, as well as a mention of the additions and improvements to the museum and library.

In his presidential address, the Rev. Abbè Laflamme confined himself mainly to a biographical sketch and a review of the scientific work of the late Dr. T. Sterry Hunt. It was a most interesting address, and we look forward with pleasure to its appearance in the proceedings of the Royal Society.

Reference was made to the royal entertainment the Society had received at our hands in Montreal last year, and our Society received high praise for the admirable manner in which it had carried out all the arrangements.

About forty papers in all were presented in the different sections. Eleven of these in the French section treated mainly on questions relating to the history of their race in America. Some of them were of the highest interest in a historical point of view.

As our delegate attended every session of the English section, he can speak of its proceedings with more confidence. Of the eight papers on the programme, four were submitted by non-members. Two of these (by missionaries among the Indians of British Columbia) were read only by title, as they gave details of observations regarding the language and mythology of these Western tribes. Another, by a delegate from Manitoba, gave an interesting description of the Archæological remains of that province. The fourth by our own delegate, was a history of the currency of Nova Scotia, with copies of many unpublished letters and documents. This paper provoked considerable discussion, eliciting some new facts on the question. Of the papers by members, two were by Rev. Dr. Patterson. That on the vocabulary of the extinct Indian race of Newfoundland was read by title. The other gave an account of the early Scottish attempt at the colonization of Nova Scotia, wherein a regular American titled aristocracy was to be founded. In another paper, by Charles Mair, one of the old mythological legends of the Ottawas was translated or paraphrased; and the fourth, by the late Sir Daniel Wilson, described the defects of our Canadian Copyright Act. On account of its interest to all the members, it was read in the General Session. As it was probably his last public utterance, those who had the good fortune to listen to him, and to his lucid replies in the discussion that followed, enjoyed a rare treat.

In the mathematical section there were five papers, all dealing with obscure questions, not calculated to interest

those who have no particular inclination towards the subject.

The natural science section is by far the best organized; both from the number and interest of the papers, and from the manner in which they are discussed. This section has also more interest to us, not only because it covers our particular work, but because four papers were by our members, and other four by former members. Of the fifteen papers presented, seven treated of geological subjects.

Without entering into any details as to the manner of treatment, the titles may be enumerated as follows :—

1. On the Diffusion and Sequence of the Cambrian Faunas.
2. On Palæozoic Corals.
3. The Fossils of the Hudson River Formation in Manitoba.
4. Illustrations of the Fauna of the St. John Group.
5. On the Correlation of Early Cretaceous Floras in Canada and the United States, and on some new plants of the period.
6. Observations on the Geology of South Western Nova Scotia.
7. On the Occurrence of Graptolites and other Fossils of Quebec Age, in the black slates of Little Metis.

There were six papers in Zoology as follows :—

8. Hybernation and Allied States in Animals,
9. Notes on Land and Fresh Water Mollusca of the Dominion.
10. On some Sponges from the Pacific Coast of Canada and the Behring Sea.
11. On the Artificial Propagation of Marine Food Fishes and Edible Crustaceans.
12. Report on a Collection of Coleoptera made on Queen Charlotte Islands.
13. The Use of Arsenites as Insecticides.

In Botany there were only two papers :—

14. Notes Supplementary on the Revision of Canadian Ranunculaceæ.
15. On the Literary History and Nomenclature of Canadian ferns.

A popular lecture on science in schools was delivered by one of our members, Dr. T. Wesley Mills, before a large aud appreciative audience, composed mainly of those interested in education. Although at first sight, the subject did not

seem attractive, the novel and attractive manner in which it was handled, held the audience to the end and carried conviction to the minds of all present.

The entertainment of the visitors, while not so elaborate as in Montreal, was not forgotten. It was altogether of a private character. At the close of one of the sessions, Mr. Sanford Fleming had an electric car in readiness which conveyed the members and delegates to his palatial residence, where during the afternoon at a reception, pleasant conversation was the order rather than dry science. At another reception at Rideau Hall, His Excellency Lord Stanley brought together a large company of citizens to meet this select gathering of Canadian scientists.

The meeting of the Royal Society of Canada of 1892, while not equal to the Montreal meeting of 1891, either in attendance or in the general interest elicited, accomplished more good in scientific research, and the privileges of these meetings, so far as they are accorded to delegates, should be used to their fullest extent by all scientific societies.

White Variety of the Fireweed.—While out camping among the Laurentian hills near Cap-a-l'Aigle, Que., last August, I came across two specimens of the common fireweed (*Epilobium angustifolium, Linn.*) having pure white flowers, instead of the well-known purple color. Although the plants were very abundant in the neighborhood, a careful search failed to reveal any more albinos.

I presume this is the variety known as *canescens*, Wood, mentioned in Macoun's Catalogue as occurring in the Mountains of British Columbia, about the Lake of the Woods, Owen Sound, and in Hastings County, Ontario. As there is no reference to its occurrence in this Province, I thought this might be of interest.

A. F. Winn.

PROCEEDINGS OF THE NATURAL HISTORY SOCIETY.

MONTREAL, October 31st, 1892.

The first monthly meeting was held this evening, the Very Rev. Dean Carmichael, President, in the chair.

The minutes of the meeting of May 30th, were read and approved.

The minutes of the Council of May 30th and October 24th were read.

The Librarian reported a large number of exchanges added to the library.

The Hon. Curator reported a Morning Warbler and Ruby Throated Humming Bird from Mr. McKee, the Horn Fly from Mr. Oswald, a large moth from A. B. McIntyre, and a number of insects from A. F. Winn.

Moved by J. S. Shearer, seconded by Dr. T. Wesley Mills that the thanks of the Society be sent to the donors.

Moved by the Rev. Robert Campbell, D.D., seconded by J. A. U. Beaudry, that as Mr. J. Stevenson Brown had through press of his private business ceased to hold office in this Society, a vote of thanks be tendered him for his long and valuable services, especially as Honorary Curator. Carried.

Moved by James Gardner, seconded by George Sumner, that the rules be suspended and that Alex. Lang be elected an ordinary member by acclamation. Carried.

Mr. J. S. Shearer appointed to interview the Provincial Treasurer with regard to a continuation of the grant had received a favorable answer. The following members participated: Hon. Senator Murphy, J. Gardner, G. Sumner, A. Holden, R. White.

Dr. T. Wesley Mills read a paper on "The preparation of the human mind for humane ideas." There was considerable discussion on the question of rabies in dogs brought out by the paper.

On motion the thanks of the Society were tendered to Dr. Mills.

The Secretary read a report as Delegate to the meetings

to the Royal Society of Canada at Ottawa. A vote of thanks was passed.

The Chairman asked what should be done with his suggestion about reviving the literary feature of the Society. Referred to the Council.

MONTREAL, November 28th, 1882.

The second monthly meeting was held this evening. The Hon. Senator Murphy, Vice-President, in the chair.

The minutes of last meeting were read and approved. The minutes of Council meeting of November 21st, were read.

The Honorary Librarian acknowledged the receipt of two pamphlets from Mr. de Beaujeu, one entitled "Le Heros de la Monongahela," the other "Documents inedits sur le Colonel de Longueuil." Also two papers read by Dr. G. M. Dawson at the meeting of the Royal Society of Canada. The thanks of the meeting were given to the donors.

On proposition of Mr. Shearer, Mr. Alfred Pennell was submitted for membership. It was agreed that the rule be suspended and Mr. Pennell was elected by acclamation.

The Rev. Dr. Campbell was then called upon to read his paper on the Flora of Montreal, in the course of which the reverend gentleman stated that he had collected and mounted 416 species of plants growing in the neighborhood of Montreal, which he will present to the Society as soon as a cabinet is provided for them. He then compared these plants with those collected by Dr. Holmes, distinguishing those which have disappeared or which have been introduced since his time. He also directed attention to the localities in which the specimens were collected. A most interesting discussion took place on the subjects brought forward in the paper.

On motion of Mr. Shearer, seconded by Mr. Shaw, a vote of thanks was unanimously tendered to Dr. Campbell.

PROCEEDINGS OF THE MICROSCOPICAL SOCIETY.

MONTREAL, March 14th, 1892.

The monthly meeting of the Society was held this evening in the Library of the Natural History Society, at eight o'clock. Present, J. Stevenson Brown, President, in the chair; Dr. Smyth, Dr. Beaudry, J. Gardner, J. A. U. Beaudry, Hon. Sen. Murphy, J. G. Shaw, A. Henderson, J. F. Hausen, E. T. Chambers, J. B. Picken, Dr. Girdwood, J. T. Donald, Leslie J. Skelton and several visitors.

The minutes of the last meeting were read and confirmed.

A letter was read from the Royal Society of Canada, advising that the eleventh general meeting of the Society would be held in Toronto on Wednesday, May 25th, and requesting a large attendance of delegates. It was moved by Alex. Henderson and seconded by J. A. U. Beaudry that Prof. Cox be requested to represent this Society, and that the Secretary be instructed to ascertain if he could do so. Carried.

Hon. Sen. Murphy stated that if an evening could be arranged, Dr. Baker Edwards would be glad to give an account of the early history of the Society. It was decided that as all the regular meetings of the Society had been already arranged for, that it would not be possible to hear Dr. Edwards' paper this session.

The question of appointing a committee to arrange the papers for next season came up, but as it was getting late, it was decided to leave the matter for next meeting.

Dr. Smyth now read the paper on "The House Spider," in which the life history of the spider, its structure and adaptability to its surroundings were all clearly and most interestingly described. The palobe eyes, organs of respiration, fangs, poison ducts and spinnerets, were each in turn carefully illustrated and explained. Remarks were made by several members and questions asked which were answered by Dr. Smyth.

A vote of thanks was proposed by Hon. Sen. Murphy,

seconded by J. A. U. Beaudry, and carried unanimously to Dr. Smyth for his instructive paper.

MONTREAL, April 11th, 1892.

The monthly meeting of the Society was held this evening in the Library of the Natural History Society. Present: J. Stevenson Brown, President, in the chair; A. T. Winn, Dr. Stirling, Geo. Sumner, J. B. Learmont, J. G. Shaw, E. T. Chambers, J. Gardner, J. S. Shearer, Dr. Beaudry, A. Holden, Dean Carmichael, J. J. McIntosh, Leslie J. Skelton, J. A. U. Beaudry and several visitors.

The minutes of the last meeting were read and confirmed.

The Secretary reported that Prof. Cox regretted he would not be able to represent the Society at the meeting of the Royal Society. It was decided to leave the matter of a delegate in the hands of Dean Carmichael, J. S. Shearer and J. A. U. Beaudry, with the understanding that this Society would not be put to any outlay in the matter.

A committee to be composed of J. Stevenson Brown, Dean Carmichael, Dr. Sterling and J. Ferrier was proposed by J. B. Learmont and seconded by Mr. Geo. Sumner, to prepare next season's programme, and it was suggested that if possible the list of papers should be completed now, so that the programme could be issued before the next meeting. Carried.

The following gentlemen were proposed and elected as ordinary members:—M. Monongahela de Beaujeu, proposed by J.A. U. Beaudry, seconded by Dr. J. A. Beaudry; F. W. Richards proposed by J. B. Picken, seconded by J. Stevenson Brown; Mr. Geo. Gebhardt proposed by J. B. Picken, and seconded by J. Stevenson Brown, was elected an associate member.

Mr. A. T. Winn now read a paper on "The American Tent Caterpillar," which was filled with practical hints to the horticulturist, as to how the eggs were deposited, how soon they germinated and the best methods of dealing with

them. Mr. Winn illustrated his remarks with diagrams, live caterpillars and a large and beautiful collection of moths of this and other species. On the conclusion of the paper a vote of thanks was moved by J. B. Learmont, seconded by Dr. Stirling, and carried unanimously, thanking Mr. Winn for his very interesting description of this caterpillar, and also for his further useful notes on how to collect moths and other insects. An interesting discussion on the paper ensued in which several members took part.

MONTREAL, May 9th, 1892.

The monthly meeting of the Society was held this evening in the Library of the Natural History Society at eight o'clock. Present: J. Stevenson Brown, President, in the chair; Dr. Girdwood, J. B. Learmont, A. T. Winn, Dr. Bruere, J. G. Shaw, Dr. Lovejoy, Jos. Bemrose, Hon. Sen. Murphy, J. S. Shearer, J. A. U. Beaudry, E. T. Chambers, J. F. Hausen, F. W. Richards, Leslie J. Skelton and several visitors.

The minutes of the last meeting were read and confirmed.

A letter was read from Dean Carmichael stating that he was going out of town, and requesting that the committee appointed to arrange a programme for next season would act during his absence.

A letter from the Secretary, Leslie J. Skelton, was read stating that as he would likely be absent from Montreal next October, the date of the next meeting, he thought it better in the interests of the Society to tender his resignation now, so that a new secretary might be appointed who would begin with the next season's work.

The question of naming a new secretary now came up and the names of Mr. A. T. Winn and Mr. J. B. Learmont, were suggested, but neither of these gentlemen was able to accept the office.

It was moved by J. A. U. Beaudry, seconded by J. B. Learmont, that the matter of a secretary be left in the

hands of the executive, and that J. Stevenson Brown, Hon. Sen. Murphy and J. S. Shearer be requested to arrange for the secretary's work until a new secretary was elected. Carried.

It was moved by J. Stevenson Brown and seconded by Hon. Sen. Murphy, that this Society desires to tender its thanks to the retiring secretary Leslie J. Skelton, for the prompt and efficient manner in which he had performed his duties, as well as for the valuable services rendered to the Society during his tenure of office. In presenting the motion, the President expressed his regret that Mr. Skelton could not continue to act as secretary and took this occasion to thank him for the kind and courteous manner in which he had aided him in the administration of the affairs of the Society. The motion was carried unanimously.

Dr. Girdwood now gave his paper on the "Use of the Microscope in the Identification of Burnt Documents." He exhibited specimens of burnt bank bills and showed how they could be identified by counting the edges, examining the different parts and by the process of photo-micography. The lecture was illustrated by photographs taken from a series of bills of the Bank of Montreal taken from a burnt postal car. In this case the use of the microscope had prevented a law suit between the bank and the insurer.

The question of the detection of forgery by the use of the microscope and camera was also carefully explained and a most interesting series of photographs taken from actual forgery cases were passed about for examination.

A vote of thanks was moved by Hon. Sen. Murphy, seconded by Dr. Lovejoy, to Dr. Girdwood for his very interesting paper. Carried unanimously.

Montreal Microscopical Society.

Montreal, 10th October, 1892.

The annual meeting of this Society was held this evening in the Library of the Natural History Society at 8 o'clock. Present: J. Stevenson Brown, President, in the chair; Hon.

Sen. Murphy, Dr. Girdwood, Geo. Sumner, J. Gardner, J. S. Shearer, F. W. Richards, E. T. Chambers. J. B. Learmont, J. F. Hausen, — Macintosh, J. G. Shaw.

The minutes of the last meeting were read and approved.

The President on behalf of the committee appointed to arrange for lectures and papers for the ensuing season, reported that the following members had promised to furnish papers:

November 14, Dr. G. P. Girdwood; December 12, Professor Cox; January 9, 1893, Prof. Adami; February 13, Prof. F. D. Adams; March 13, Dr. Bruere; April 10, Dr. McConnell.

Dr. Girdwood reported that as requested by the Society he had acted as their representative at the meeting of the Royal Society of Canada at Ottawa, and dilated on the work and progress in research being made by its members during the season. A cordial vote of thanks to the Doctor for the able manner in which he had fulfilled his mission was proposed by Mr. J. S. Shearer, seconded by Geo. Sumner, and carried unanimously.

The following gentlemen were proposed as members :—Mr. W. C. McDonald, 891 Sherbrooke street, associate member; Rev. Dr. Campbell, 68 St. Famille street, ordinary member; Mr. C. T. Williams, 26 Chomody street, ordinary member, by the President, seconded by Mr. J. Gardner, and carried unanimously.

The Secretary's report was read by Mr. J. S. Shearer who had acted as Secretary *pro. tem.*, and on motion of the Hon. Sen. Murphy, seconded by Mr. Jas. G. Shaw, was adopted.

Mr. Shearer as treasurer reported that the Society has now $101 deposited in the bank, and also the very gratifying statement that no member was in arrear of dues. The report was signed by Messrs. Gardner and Sumner, auditors. Mr. Shearer was thanked by the members for his statement.

The election of officers of the Society for the ensuing year was now proceeded with, resulting as follows :—

President—Dr. G. P. Girdwood, M.D., M.R.C.S. Eng., pro-

posed by Hon. Sen. Murphy, seconded by Mr. J. S. Shearer.

Vice-President—Dr. J. W. Stirling, proposed by Mr. J. S. Shearer, seconded by Mr. J. Gardner.

Treasurer—Mr. J. S. Shearer, proposed by Mr. Geo. Sumner, seconded by Mr. F. W. Richards.

Secretary—Mr. Jas. G. Shaw, proposed by Mr. Geo. Sumner, seconded by Mr. J. S. Shearer, whose election was carried unanimously.

Each of the newly appointed officers thanked the members for the high honor bestowed upon them by election to such very important offices.

By a unanimous vote the retiring officers received the thanks of the meeting for their close attention and zeal manifested in promoting the welfare of the Society during their term of office.

The retiring President, Mr. J. Stevenson Brown, in congratulating the Society upon its selection of officers, took occasion to thank the members for the kindly manner in which they had assisted him in the administration of the affairs of the Society during his three years of office. He expressed his gratitude for the perfect harmony which had characterized all its meetings and bespoke the same kind consideration for his successor whom he had now the pleasure of calling to the chair.

The new President, Dr. Girdwood, having assumed the chair, first thanked the Society for the honor they had conferred upon him and promised he would use his best endeavours to further its interests, and then called upon the retiring president to deliver his annual address, which he then did, taking for his subject "The Microscope as an Educator," which he treated in an exhaustive manner and was listened to with marked attention, and at the close Mr. Brown was greeted with applause, and received a cordial and hearty vote of thanks.

A committee composed of the President, Secretary, Dr. McConnell and J. Stevenson Brown, were desired to consider what means could be taken to inaugurate meetings for instruction in the use of the microscope. Approved.

MONTREAL, 14th November, 1892.

The monthly meeting of this Society was held this evening in the Library of the Natural History Society at 8 o'clock, Present: Dr. Girdwood, President, in the chair; Rev. Dean Carmichael, Messrs. Geo. Sumner, Gardner, J. Stevenson Brown, Ferrier, Richards, Dr. Wanless, J. A. U. Beaudry, E. T. Chambers.

Dr. Girdwood presented to the Society four (4) volumes of "Cole's Studies in Microscopical Science," now very scarce. Mr. J. S. Brown in proposing a vote of thanks to Dr. Girdwood, spoke of the value of the books presented as he had had an opportunity of looking over them and proposed that they should be substantially bound. The Rev. Dean Carmichael in seconding the motion, called the attention of the members to the advantage it would be to the Society were a bookcase provided in which any books, papers or slides belonging to it could be kept secure. The vote of thanks was carried unanimously.

Mr. E. R. Barton, 58 Beaver Hall Hill, was proposed as an ordinary member by Mr. F. W. Richards, seconded by Mr. J. S. Brown.

Rev. Dean Carmichael proposed, seconded by Mr. Geo. Sumner, that the providing of a bookcase be referred to the committee appointed at the last meeting for the formation of classes for instruction.

As there had been a considerable amount of business talked over and the evening was far advanced, it was proposed to call a special meeting for Monday evening the 21st inst., to hear Dr. Girdwood's address. Dr. Girdwood having acquiesced in this proposition a resolution to that effect was carried unanimously.

The meeting then adjourned.

MONTREAL, 21st November, 1892.

A Special meeting of the Society was held this evening in the Library of the Natural History Society, University street, to hear a paper read by Dr. Girdwood, President of the Society.

Present: Dr. Girdwood, President; Dr. Stirling, Vice-President. Messrs. J. S. Shearer, Treasurer; E. T. Chambers, Jas. Gardner, Dean Carmichael, Canon Empson, Hon. Sen. Murphy, J. B. Learmont, J. A. U. Beaudry, Chas. D. Williams, Prof. Cox, J. Stevenson Brown, F. W. Richards, J. F. Hausen, E. R. Barton, Dr. McConnell and a number of visitors.

The Secretary read the resolution carried at the last meeting, calling a special meeting for this evening.

The 1st Vice-President, Dr. Stirling, was then called to the chair, and after a few remarks he requested Dr. Girdwood to address the meeting, his subject being "The Microscope, its Construction and Application."

Dr. Girdwood first took up the subject of refraction and explained it in all its details, after which by numerous diagrams he showed how the rays of light were affected according to the different styles of lenses through which they passed, and explained how by a combination of different lenses the object was magnified, and the image carried to the eye. This was proved by practical illustration. The lecture was replete with valuable information and was delivered in the doctor's usual clear style and listened to with marked attention. Considerable discussion followed and the doctor gave further information on the subject by replying to the questions put to him.

After a very hearty vote of thanks was accorded the lecturer the meeting adjourned.

MONTREAL, 12th December, 1892.

The regular monthly meeting of this Society was held this evening in the Physics Building, McGill College, by invitation of Prof. John Cox, B.A., on account of its being hazardous to remove the apparatus required to illustrate the lecture on "Polarized Light, its Application in Microscopical Research."

The chair was taken by the President, Dr. Girdwood, and a considerable number of the members were present. A

large and appreciative audience filled the theatre and the President introduced Prof. Cox to the audience, promising them a most entertaining and instructive lecture on the subject chosen. The professor illustrated very clearly the different subjects on which he discoursed, and at the close on motion of Dr. Girdwood received a marked appreciation of thanks from the large audience.

The following new members were proposed and elected:

Prof. J. G. Adami, M.D., proposed by Dr. Girdwood, seconded by Mr. Jas. G. Shaw; Rev. Edmund Wood, M.A., proposed by Mr. J. B. Picken, seconded by Mr. J. Stevenson Brown; Mr. F. L. Wanklyn proposed by Mr. Albert Holden, seconded by Mr. Jas. G. Shaw.

Notices of Books and Papers.

Tiefencontacte an den intrusiven Diabasen von New Jersey von A. Andreae und A. A. Osann—Verhandlungen des Naturhist-Med Vereins zu Heidelberg, V Bd. 1 Heft., 1892.

This paper by Professors Andreae and Osann of Heidelberg, treating as it does of the contact of the great intrusive Diabases forming the Palisades of the Hudson with the "Newark Shales," is of interest to all American geologists. The publication in which the paper appears has unfortunately a somewhat limited circulation especially in America, and it has therefore been thought advisable to give a somewhat extended notice of it in the *Record of Science.*

The paper is one of a number on various subjects connected with American Geology which have recently been published by European geologists who visited America to attend the International Congress of Geologists held in Washington in the summer of 1891. The geological relations of these traps have been worked out by Mr. N. H. Darton, and described by him in his pamphlet on "The Relations of the Traps of the Newark System in the New Jersey Region," (Bull. No. 67, U. S. Geol. Survey, 1890.) In this region the strata of the "Newark system," which are generally of Upper Triassic age, are associated with eruptive diabases, which being hard, resisting erosion and following pretty closely the strike of the sedimentary strata, cross the country as abrupt cliffs 300-400 feet in height and form marked features in the landscape.

Those diabases lying to the west of the Watchung Mountains, and therefore higher up in the series forming the so-calling "Watchung traps" are as Prof. Davis has shown effusive masses, but the "Palisade traps," lying further east and lower down in the Newark strata and which form the celebrated Palisades on the Hudson River, are true intrusive sheets. Where the diabase constituting these Palisade traps comes in contact with the Newark shales along its lower face, these latter are much altered, but the alteration is not the ordinary alteration into Spilosite, Desmosite or Adinole, nor does the diabase itself assume the usual variolitic structure, but the contact products resemble much more closely those ordinarily found in connection with Plutonic rocks, and may be classed as follows :—

1. Normal Hornstones, which cannot be distinguished from those found in connection with Plutonic rocks.

2. Hornstone containing a large amount of Tourmaline. This mineral is transparent and of a grey and brown colour and usually has a well marked zonal structure.

3. Contact rocks derived from the alteration of arkoses and which are characterized by the development in them of a fibrous green hornblende.

4. Lime-silicate Hornstones ("Kalksilicathornfelse").

A fact of especial interest, on account of its bearing on the subject of regional metamorphism,[1] is that the lines of separation beween the different hornstones which represents rocks of very different chemical composition, are even when examined under the microscope, perfectly sharp and well defined.

The principal results of the investigation may be summed up as follows:—

1. The diabase of Jersey City belongs to the group of the quartz bearing hypersthene diabases and forms, according to American geologists, an intrusive sheet. The hanging wall has been for the most part removed by erosion, while the lower contact is characterized by what is for diabase a series of very peculiar contact products.

2. The diabase at its lower contact not only becomes finer in grain, but shows an alteration in both structure and chemical composition. The ophitic structure of the normal diabase passes over into a typical porphyritic structure, while the hypersthene disappears and its place is taken by olivine. Biotite also which occurs but very sparingly in the normal diabase, becomes more abundant.

[1] Rosenbusch—"Zur Auffassung der chemischen Natur des Grundgebirges," Tscher. Min, u. Pet. Mittheil, 1891, p. 52.

3. The sedimentary rocks of the "Newark system," which have been altered by the diabase were originally clay slates with interstratified limestones and arkoses. The products of their alteration are a series of hornstones which differ entirely from those usually found at diabase contacts. The conclusion reached by the American geologists from stratigraphical considerations that the Palisade diabase forms an intrusive sheet, is in this way confirmed.

4. The microscopically sharp bounderies of the hornstones, resulting from the alteration of the various rocks, against each other, as well as the perfect preservation of the original relations of the rocks in question, as for instance the change in character of materials from layer to layer or the cracked and brecciated structure shows that the alterations took place while the rocks were in a solid or at least but slightly plastic condition.

Diabase contacts of a somewhat similar character have been described by Brogger, from Norway ([1]), by Cohen, from South Africa ([2]), and by Verbeek, from Sumatra ([3]).

[1]. "Die Mineralien der Syenitpegmatitgänge der südnorwegischen Augit und Nephelinsyenite," Zeit. für Kryst, Bd. 16, p. 20.

[2]. "Geog.-Pet. Skizzen aus Süd Africa," Neues Jahr. für Min. V Beil. Bd., p. 251.

[3]. See Rosenbusch.—"Physographie der Massigen Gesteine." p. 244.

Frank D. Adams.

Experimental Farms: Appendix to the Report of the Minister of Agriculture, pp. 348, Ottawa, S. E. Dawson, Queen's Printer, 1892.

Evidence of Mr. James Fletcher, Entomologist and Botanist before the select Standing Committee of the House of Commons, on Agriculture and Colonization, Session of 1892, pp. 19, Printed by Order of Parliament.

These publications are of great scientific interest, as well as of vast practical utility. If all the investments of public money, by the Government of Canada, were as judiciously made as the 75,500 odd dollars expended upon the Experimental Farm, near Ottawa, and the four branches at Nappan, N.S.; Brandon, Manitoba; Indian Head, North-West Territories; and Agassiz, British Columbia respectively, there would not be much room for criticism of its expenditure. Agriculture, with its allied pursuits of horticulture and arboriculture, is the main industry of Canada, and is likely to continue so for generations to come; and it is wise statesmanship which brings all the resources of science and art to bear upon its

development and advancement. Indeed, it is only the application of the best scientific knowledge and the use of the latest improvements in apparatus that make it possible for the modern tiller of the soil to maintain himself. The old-time farmer, who merely followed the example of his father in his methods, and was ignorant of the processes of nature farther than these came practically under his observation, and conducted his routine of yearly operations largely by main force, in a spirit of haphazard, without regard to economic laws, has no chance in competition with the man who has made an earnest study of the science of agriculture, and applies its principles rigidly in the practice of his calling. The establishment of agricultural colleges, and the holding of conventions in local centres, so as to gain the ear of the entire farming community, must be spreading a higher degree of intelligence among our rural population, which cannot but tell upon the future course of agriculture in this country. It will not do to place supreme reliance upon the virgin qualities of the soil, and to expect mother earth to go on yielding nourishment from her bosom for successive generations, without her being herself rejuvenated. She needs nursing in her turn, and trained nurses alone can treat her according to her requirements. Every farmer in the Dominion would do well to read the reports of the experts employed at the Central Farm, as contained in the Government Blue Book. Every page is charged with instructive matter with which he ought to make himself acquainted. From the Directors' Report he would learn what particular varieties of grain, roots and trees are best adapted to the district in which he resides, and the fact that 12,285 kindly were distributed among 5,140 applicants, shows a keen appreciation of the advantages which the Experimental Farm affords to those for whose benefit it was established. Prof. Robertson, in his report, gives details showing the relative profitableness of different breeds of cattle and swine, dealing with the live questions regarding dehorning and feeding of calves, the value of ensilage and other descriptions of fodder, the best methods of dairying,—and all the advice he offers is the result of careful experiment. Fruit growing is developing into an important industry in Canada, and as improvements in communication with the old world advance, bringing us closer to the European markets, a bright future is unquestionably in store for Canadian orchardists. Those who are staking anything on this line of business should read with care what Mr. John Craig, our national horticulturalist, has written on the subject in his report. If Canada is to achieve distinction in horticulture and our gardeners and fruit growers would add to their wealth, it must be by producing the varieties best suited to our climate and soil.

What these are they will discover by studying Mr. Craig's notes on the subject. The people of Manitoba and the North-West Territories will be particularly interested in the experiments now making in the growing of forest trees in their vast, bare prairies, of which an account is given in this Blue Book. Not the least interesting part of this volume scientifically as well as from a utilitarian point of view, is the report of Mr. F. T. Shutt, M.A., chemist to the Central Experimental Farm. It sets forth in detail the results obtained by different kinds of fertilizers applied to the soil, and gives the analysis of varieties of cattle feed, showing which are the best milk producers, and affords advice as to the chemical remedies to be employed in destroying vermin on cattle, and insect pests on trees. His report deals with the scare produced by the enemies in Great Britain of Canadian fruit, who spread through the English papers a rumuor that our apples were dangerous, through the absorption of Paris green. Mr. Shutt demonstrates the scientific absurdity of the charge against our fruit. Mr. A. G. Gilbert, poultry manager at the Central Experimental Farm, briefly reports on the most thrifty and profitable breeds of hens, and on the best feed for them, giving specially useful hints regarding the winter treatment for poultry, which is one of the difficult problems of our climate.

If the Experimental Farm Report disseminated no other information than that contained in the section of it furnished by Mr. James Fletcher, Entomologist and Botanist, it would well repay the country to have it printed and spread broadcast. It deals with all the insect pests, and weeds and fungi, which vex the farmer's righteous soul, and advises him how to fight them. And their names are legion. Here is a list of these foes of agriculture and horticulture dealt with in the report:—*Cutworms, Black Army Worm, Grain Plant Louse, Tomatoe Stalk-borer, Buffalo Tree-hopper, Blister Beetles, Hop Aphis, Cigar Casebearer of the Apple, Pearleaf Blister, Clover Root-borer, Oat-weevil, Eye-Spotted Bud-Moth, Cankerworm, Leafrollers, Pea-Weevil, Oyster Shell Bark Louse, Pear-Tree Slug, Red Turnip-Beetle, Apple Maggot, Codling Moth, Plum Curculio, Potato Rot* and *Grape Mildew.* Mr. Fletcher tells how the invasions of these enemies are to be warded off, and how they are to be treated at close quarters. Dealing with the vegetable kingdom, he instructs our agriculturists how to deal with the inroads made into different parts of the Dominion of certain obnoxious weeds, mentioning particularly pepper-grass (*Lepidium intermedium*), penny-cress (*Thlaspi arvensis*), purslane (*Portulaca oleracea*), common Ragwort (*Senecio Jacobæa*), perennial sow thistle (*Sonchus arvensis*), burdock (*Lappa officinalis*), wild chicory (*Cichorium Intybus*), orange daisy (*Rudbeckia hirta*), ox-eye daisy (*Chrysan-*

themum Leucanthemum), Canadian Fleabane (*Erigeron Canadense*), Canada thistle (*Cnicus arvensis*), couch grass (*Agropyrum repens*), wild oats (*Avena fatua*), and chess (*Bromus secalinus.*)

But Mr. Fletcher's *brochure* is not all negative. It has valuable suggestions showing what to cultivate as well as what to pull up. The experiment making in grasses on the Central Farm, is most important in its bearing on the future history of the agriculture of this country. The raising of stock is as yet only in its infancy in the Dominion, and the possibilities in this connection are immense. If we have native grasses that can be generally utilized, specially suited to our climate and of high nutritive qualities, the bringing of these prominently under notice cannot but give a new impulse to the breeding of cattle and horses for the European markets. Mr. Fletcher's Report contains woodcuts of ten of our native grasses, by which the most inexpert reader will be easily able to identify them, as they are described in the text of the Report, and as they are found in nature.

The pamphlet, embracing Mr. Fletcher's evidence before the Select Committee of the House of Commons, enlarges upon the topics touched on in his report and in that of the Director of the Experimental Farm, and dwells on many additional points of great importance, on which a want of space forbids remark at length. Our readers are referred to the *brochure* itself, if they desire detailed information regarding it. A later bulletin of Mr. Fletcher's deals with the "Horn Fly," (*Hæmatobia Serrata*), the most recent of the pests by which our farmers are afflicted, and gives a specific for its destruction, "Kerosene Emulsion," and instructions how to apply the same.

ROBERT CAMPBELL.

1892.

C. H. McLEOD, *Superintendent.*

Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
95	....	....	....	1
68	....	....	....	2 .... SUNDAY
52	0.38	....	0.38	3
90	Inap.	....	0.00	4
20	Inap.	....	0.00	5
15	....	....	....	6
56	0.02	....	0 02	7
34	Inap.	....	0.00	8
76	....	....	....	9 ....SUNDAY
00	0 02	....	0.02	10
38	0.02	....	0.02	11
98	....	...	....	12
64	....	....	....	13
89	....	....	....	14
39	0.22	....	0.22	15
20	0.05	....	0.05	16 .... .SUNDAY
93	....	....	....	17
00	...	....	....	18
36	0.40	....	0 40	19
83	....	....	...	20
96	....	....	....	21
92	....	....	..	22
37	Inap.	....	0.00	23 ....SUNDAY
49	....	....	....	24
12	Inap.	....	0.00	25
00	0.16	....	0.16	26
09	0.02	....	0.02	27
36	0.01	....	0.01	28
00	0.27	....	0.27	29
56	Inap.	....	0.00	30 .. ..SUNDAY
00	Inap.	....	0.00	31
¶46.9	1.57	....	1.57	Sums ....
41.1	3.22	1.48	3.38	18 Years means for and including this month.

was 98 on the 3rd. Minimum relative humidity was 41 on the 21st.

Rain fell on 18 days.

Snow fell on 1 day.

Rain or snow fell on 18 days.

Auroras were observed on 3 nights.

Hoar frost on 2 days.

Fog on 2 days.

NOTE.—This is the only month of October in 18 years on which the temperature has not fallen below freezing.

R, 1892.

t C. H. McLEOD, *Superintendent.*

DED RS. Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
4	12	0.05	....	0.05	1
10	00	0.24	4.9	0.94	2
7	00	0 03	....	0.03	3
10	00	0.03	0.6	0 09	4
8	04	....	5.5	0.52	5
..	30	....	....	....	6 ....SUNDAY
6	00	0.08	....	0.08	7
6	00	0.05	....	0.05	8
0	35	....	....	....	9
0	00	....	7.3	0.67	10
0	98	....	....	....	11
10	00	0.02	1.3	0.16	12
..	00	....	0.3	0.03	13 .... .SUNDAY
7	00	....	....	....	14
0	02	....	....	....	15
0	00	0.45	....	0.45	16
0	58	....	...	...	17
8	09	0.41	....	0.41	18
0	13	....	....	....	19
..	94	....	....	..	20 ....SUNDAY
0	03	....	0.2	0.02	21
7	09	....	0.5	0.06	22
0	00	....	0.6	0.05	23
0	25	....	0.8	0.08	24
10	05	....	0.1	0.01	25
0	10	....	....	....	26
..	00	....	....	....	27 .. ..SUNDAY
1	01	....	....	....	28
0	37	....	....	....	29
10	00	....	....	..	30
....	14.8	1.36	22.1	3.70	Sums ....
....	¶29.0	2.37	13.3	3.72	18 Years means for and including this month.

nd was 97 on the 4th and 16th. Minimum relative humidity was 51 on the 9th.

Rain fell on 9 days.

Snow fell on 11 days.

Rain or snow fell on 17 days.

Lunar halo on 1 night.

1892.

C. H. McLEOD, *Superintendent.*

Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
00	....	0.1	0.01	1
53	....	....	.. .	2
00	....	0.8	0.06	3
00	....	0.4	0.04	4 ....SUNDAY
13	....	....	....	5
00	....	1.1	0.11	6
16	....	Inap.	Inap.	7
07	0.76	....	0.76	8
00	....	....	....	9
00	....	....	....	10
21	....	0.5	0.05	11 .... .SUNDAY
01	....	0.2	0.01	12
07	....	....	....	13
00	....	4.9	0.50	14
00	0.04	Inap.	0.04	15
51	....	0.2	0.02	16
60	....	Inap.	Inap.	17
07	....	0.3	0.02	18 ....SUNDAY
00	....	2.5	0.25	19
80	....	....	...	20
09	....	0.3	0.03	21
00	....	....	..	22
84	....	....	....	23
00	....	....	....	24
00	....	1.0	0.10	25 ....SUNDAY
44	....	....	....	26
09	....	....	....	27
67	....	....	....	28
67	....	....	....	29
01	....	....	....	30
00	....	Inap	Inap.	31
19	0.80	12.3	2.00	Sums ....
28.4	1.36	23.1	3.63	18 Years means for and including this month.

was 98 on the 14th. Minimum relative humidity was 56 on the 22nd.

Rain fell on 2 days.

Snow fell on 16 days.

Rain or snow fell on 17 days. Hail fell on 1 day.

Auroras were observed on 2 nights.

Hoar frost on 3 nights.

Lunar halo on 2 nights.

Lunar corona on the 26th.

ear 1892.

Observa titude N. 45° 30′ 17″. Longitude $4^h\ 54^m\ 18^s.55$ W.

C. H. McLEOD, *Superintendent.*

Month.	Inches of rain.	Number of days on which rain fell.	Inches of snow.	Number of days on which snow fell.	Inches of rain and snow melted.	No. of days on which rain *and* snow fell.	No. of days on which rain *or* snow fell.	Month.
January	0.73	5	39.7	22	4.59	3	23	January
February	0.00	0	36.4	16	3.27	0	16	February
March	0.29	5	34.6	10	3.84	5	10	March
April	1.01	9	7.2	5	1.73	1	13	April
May	2.20	15	...	..	2.20	..	15	May
June	8.00	22	0.	..	8.00	..	22	June
July	2.95	18	0.	..	2.95	..	18	July
August	5.24	13	..	..	5.24	.	13	August
September	2.92	10	....	.	2.92	.	10	September
October	1.57	18	...	1	1.57	1	18	October
November	1.36	9	22.1	11	3.70	3	17	November
December	0.80	2	12.3	16	2.00	1	17	December
Sums for 1892	27.07	126	152.3	81	42.01	14	192	Sums for 1892
Means for 1892	....	....	....	....	3.50	..	16	Means for 1892
Means for 18 years ending Dec. 31, 1892.	28.07	134	123.6	83	40.09	16	....	Means for 18 years ending Dec. 31, 1892.

The great s therefore 104.6. Greatest range of the thermometer in one day was 35.3 on February 26 uary 20th when the mean temperature was 7°.7 below zero. The highest barometer read ve humidity was 16 on April 20th. The greatest mileage of wind recorded in one hour wa The resultant direction of the wind for the year was N. 85° W., and the resultant milea nights. Lunar corona on 1 night. Solar halos on 2 days, and on May 10th Solar Halo wit rst snowfall of the autumn was on October 31st. The first sleighing of the winter was on N

NOTE.—T

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THE CANADIAN
RECORD OF SCIENCE

INCLUDING THE PROCEEDINGS OF
THE NATURAL HISTORY SOCIETY OF MONTREAL,
AND REPLACING

THE CANADIAN NATURALIST.

CONTENTS.

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THE

CANADIAN RECORD

OF SCIENCE.

VOL. V. APRIL, 1893. NO. 6.

Notes on the Gasteropoda of the Trenton limestone of Manitoba, with a description of one new species.[1]

By J. F. Whiteaves.

According to the latest researches of the officers of the Canadian Geological Survey, the Trenton limestone of Lake Winnipeg and the Red River valley in Manitoba consists "at the bottom of a mottled buff and grey dolomitic limestone, found at Big and Swampy Islands, etc., and probably also at East Selkirk, above which are other horizontal evenly bedded limestones and dolomites, amounting in all to a few hundred feet and all more or less rich in fossils."[2] In the present communication the words Trenton limestone will be used to designate all those rocks which intervene between the white quartzose sandstone which is supposed to be the local representative of the St. Peter's sandstone of Wisconsin, etc., and the Hudson River formation, thereby including all those rocks in Manitoba which have previously been referred to the Galena limestone.

[1] Communicated by permission of the Director of the Geological Survey of Canada.

[2] Tyrrell, Trans. Roy. Soc., Canada, for 1891, vol. IX, sect. 4, p. 91.

The specimens to which these notes refer are, with very few exceptions, in the Museum of the Geological Survey at Ottawa, and in the enumeration of the different species it has not been thought either necessary or desirable to quote all their synonyms and references, but only such as are most likely to be useful to Canadian students.

RAPHISTOMA LENTICULARE.

Pleurotomaria lenticularis (Sowerby) Hall. 1847. Pal. St. N. York vol. I, p. 172, pl. xxxviii, fig. 6.

" " " Owen. 1844. Geol. Rep. Iowa, Wisc. and Minn., p. 86, pl. xviii, fig. 6.

Pleurotomaria Americana, Billings. 1860. Can. Nat. and Geol., vol. VI, p. 164, fig. 7.

Pleurotomaria lenticularis (Sowerby) Nicholson. 1875. Rep. Palæont, Prov. Ont., p. 19, fig. 7d.

Raphistoma lenticularis, Whitfield. 1882. Geol. Wiscons., vol. IV, p. 214, pl. vi, figs. 4 and 5.

Lower Fort Garry, D. Dale Owen, 1848. Cat Head, Lake Winnipeg, T. C. Weston, 1884: one specimen. Birch Island, Kinwow Bay, Lake Winnipeg, T. C. Weston, 1884, one specimen, and Messrs. Dowling & Lambe, 1890, two specimens. One or two specimens of this species, also, were collected by Messrs. Dowling & Lambe in 1890 and 1891, at the Dog's Head and at Commissioners (or Cranberry), Snake, and Little Tamarack islands, Lake Winnipeg.

All the specimens collected at these localities are badly preserved casts of the interior of the shell. They are obviously conspecific with the fossils from the Trenton limestone of the States of New York and Wisconsin, which Professors Hall and Whitfield have identified with the *Pleurotomaria lenticularis* of Sowerby. Similar, but sometimes better preserved specimens, are common in the Trenon limestone of Ontario and Quebec, and in the Hudson-River formation of the Island of Anticosti.

Salter, however, in 1859, expressed the opinion that the

American fossils which had then been referred to *P. lenticularis*, Sowerby, are distinct from that species, and in the following year E. Billings maintained that three species, which he then described and figured under the names *Pleurotomaria Progne*, *P. Americana* and *P. Helena*, had been mistaken for the true *P. lenticularis*. The specimens so far collected in Manitoba are too imperfect to be identified with much certainty, but they all appear to belong to the form which Billings proposed to distinguish as *P. Americana*.

Lindström, on page 108 of his valuable monograph "on the Silurian Gasteropoda and Pteropoda of Gothland," states that the shell which Conrad figured as *P. lenticularis*, Sowerby, in 1848, in Emmons' Geological Report of the Third District of the State of New York, is *P. qualteriata*, Schlotheim, and that it is "quite different" from the *P. lenticularis* of Hall.

PLEUROTOMARIA SUBCONICA.

Pleurotomaria subconica, Hall. 1847. Pal. St. N. York, vol. I, pp. 174 and 304, pls. xxxvii, fig. 8, & xxxviii, fig. 3.

" " Billings. 1863. Geol. Canada, p. 180, fig, 174.

" " Whitfield. 1882. Geol. Wiscons., vol. IV. p. 216, pl. vi, fig. 1.

The Dog's Head (two specimens), and Stony Point (one specimen), Lake Winnipeg, T. C. Weston, 1884.

PLEUROTOMARIA MURALIS.

Pleurotomaria muralis, D. D. Owen. 1852. Rep. Geol. Surv. Wisc., Iowa and Minn., p. 581, pl. ii, fig. 6.

"Lower Fort Garry, Red River of the North," Owen (op. cit., p. 626). A natural mould of the exterior of the est of the upper portion of a specimen, collected by Dr. R. Bell, in 1879, at the Limestone Rapid 100 miles up the Nelson River, Keewatin, and a very badly preserved specimen collected by Mr. Dowling, in 1891, at the Dog's Head, Lake Winnipeg, are both possibly referable to this species.

Murchisonia milleri.

Murchisonia bicincta, Hall. 1847. Pal. St. N. York, vol. I, p. 177, p. xxxviii, figs. 5a–h. But not *M. bicincta*, McCoy, 1846.
" " Salter. 1859. Geol. Surv. Can., Org. Rem., Dec. 1, p. 19, pl. iv, figs. 5 & 6.
Murchisonia Milleri, Hall, 1877. In Miller's Am. Pal. Foss., ed. I, p. 244.
Pleurotomaria bicincta, Lindstrom. 1884. Sil. Gastr. and Pterop. Gothland, p. 106, pl. viii, figs. 15–25.

Elk Island, Lake Winnipeg, Dr. A. R. C. Selwyn, 1872: one imperfect and badly preserved specimen. Snake Island (near the Dog's Head) in the same lake, Messrs. Dowling and Lambe, 1890: a well preserved mould of the exterior of the shell.

Murchisonia gracilis.

Murchisonia gracilis, Hall. 1847. Pal. St. N. York, vol. I, p. 181, pl. xxxix, figs. 4, a, b, c.
" " Salter. 1859. Geol. Surv. Can., Can. Org. Rem., Dec. 1, p. 22, pl. v, fig. 1.
" " Billings. 1863. Geol. Canada, p. 183, fig. 178.
" " Nicholson. 1875. Rep. Pal. Prov. Ont., p. 18, fig. 7c.

Snake Island, Messrs. Dowling & Lambe, 1890: four casts of the interior of the shell.

Murchisonia bellicincta, var. teretiformis.

Murchisonia teretiformis, Billings. 1857. Geol. Surv. Can. Rep. Progr. 1853–56, p. 298.
" " " 1886. Cat. Sil. Foss. Isld. Anticosti, pp. 18 & 55.
Murchisonia bellicincta, Whiteaves. 1880. Geol. Surv. Can., Rep. Expl. and Surv., 1878–79, pp. 47c, and 48c.
Cfr. also *Murchisonia major*, Hall. 1851. In Foster and Whitney's Rep. Geol. Lake Super. Land Distr., p. 209, pl. xxvi, figs. 1 a–c.
" " Whitfield. Geol. Wiscons., vol. IV, p. 244, pl. ix, fig. 4.

One of the most abundant species of gasteropoda in the Trenton limestone of Manitoba is a large *Murchisonia* which the present writer has identified with the *M. major* of Hall, but which does not seem to differ materially from *M. bellicincta* except in size. Specimens of this *Murchisonia* (which had previously been collected at two localities on the Nelson River in Keewatin by Dr. R. Bell in 1879), were obtained by Mr. Weston, in 1884, at East Selkirk and Lower Fort Garry, at Elk, Big and Deer Islands, Big Grindstone Point, the Dog's Head, and Jack Fish Bay, Lake Winnipeg; by Mr. Tyrrell in 1889 at Berens (or Swampy) Island; and by Messrs. Dowling & Lambe in 1890 at Black Bear, Snake, Little Tamarack and Jack Head islands, in Lake Winnipeg. All the specimens from these localities, like those of *M. major* from Wisconsin, are mere casts of the interior of the shell, which are imperfect at both ends but especially so at the larger end. They rarely exceed four inches and a half in length and not more than six volutions are preserved. Not a vestige of the surface ornamentation can be detected on any of them, and indeed Professor Whitfield has expressed the opinion that the fossils from the States of New York and Wisconsin, which have been described as *M. bellicincta* and *M. major*, are not true Murchisonias, as, so far as he has observed, "none of them show any evidence of having been marked with a revolving band." In regard to the typical form of *M. bellicincta* it may be remarked that Ferdinand Roemer has figured a European specimen of it, in which the spiral slit-band, and backwardly divergent growth lines are clearly shown on each of the volutions, on Plate v, fig. 7, of the Atlas to the first volume of the Lethæa Geognostica, published in 1876.

In 1890 Messrs. Dowling & Lambe collected, at Berens Island, Lake Winnipeg, two specimens which throw quite a new light on this point and upon the characters and affinities of this large variety of *M. bellicincta*. One of these is upwards of seven inches and the other fully eight inches in length, and nine volutions can be counted in each. The shorter of the two has the test preserved on the last two

volutions, though the whole of the specimen has obviously been subjected to abnormal and lateral compression. Its surface markings consist of a broad, flat and nearly central, spiral slit-band, to which the growth lines on each side converge obliquely backward. Apart from its abnormal compression, this specimen is essentially similar in size, shape and surface markings, to the specimens from Gamache Bay, Anticosti, which Mr. Billings refers to his *M. teretiformis* (op. cit., p. 55) and upon which he bases the statement that "this species has a wide flat band about the middle of the whorl and appears to be a large variety of *M. bellicincta*, Hall."

It would thus appear that *M. major*, Hall, and *M. teretiformis*, Billings, are most probably synonymous, the former having been based upon very imperfect casts of the interior or the shell, and the latter upon more perfect and at least partially testiferous specimens. The name *teretiformis* is here used in a varietal sense, on the ground that it was the first prefixed to a sufficiently accurate diagnosis of the characters of the shell.

BUCANIA (TREMANOTUS?) BUELLII.

Bucania Buelli, Whitfield. 1878. Ann. Rep. Geol. Surv. Wiscons. for 1877, p. 76.

Bucania (*Tremanotus*?) *Buelli*, Whitfield. 1882. Geol. Wiscons., vol. iv, p. 224, pl. vi, figs. 12–14.

Lower Fort Garry, Dr. R. Bell, 1880, one specimen, and Commissioners, formerly called Cranberry Island, D. B. Dowling, one specimen, both of which are badly preserved casts of the interior of the shell.

BUCANIA SULCATINA.

Bellerophon sulcatinus, Emmons. 1842. Geol. Rep., 2nd Distr. N. York, p. 312, fig. 4.

Bucania sulcatina, Hall. 1847. Pal. St. N. York, vol. I, p. 32, pl. vi, figs. 10, 10 a.

Bellerophon sulcatinus, Billings. 1863. Geol. Canada, p. 146, fig. 96.

A single specimen of this species was found loose, on

Reindeer Island, by Mr. Dowling, in 1890, but no specimens have yet been collected, in place, in the Trenton limestone of Manitoba.

BUCANIA BIDORSATA.

Bucania bidorsata, Hall. 1847. Pal. St. N. York, vol. I, p. 186, pl. xl, figs. 2 a–g.

Birch Island, Kinwow Bay, Lake Winnipeg, Messrs. Dowling & Lambe, 1890: one specimen.

CYRTOLITES COMPRESSUS.

Phragmolites compressus, Conrad. 1838. Ann. Rep. N. York St., p. 119.
Cyrtolites compressus, Hall. 1847. Pal. St. N. York, vol. I, p. 188, pl. xl, figs. 2 a–f.

Lower Fort Garry, Dr. R. Bell, 1880: one small but well preserved and very characteristic specimen. East Selkirk, A. MacCharles, 1884: a large cast of the interior of the shell.

EUNEMA STRIGILLATUM.

Eunema strigillata, Salter. 1859. Geol. Surv. Can., Can. Org. Rem., Dec. 1, p. 29, pl. vi, fig. 4.
" " Billings. 1863. Geol. Canada, p. 145, fig. 88.

Lower Fort Garry, T. C. Weston, 1884: one nearly perfect and well preserved specimen.

HELICOTOMA PLANULATA.

Helicotoma planulata, Salter. 1859. Geol. Surv. Can., Can. Org. Rem., Dec. 1, p. 14, pl. ii, figs. 5–7.

East Selkirk, A. MacCharles, 1884: one good specimen, with the test preserved.

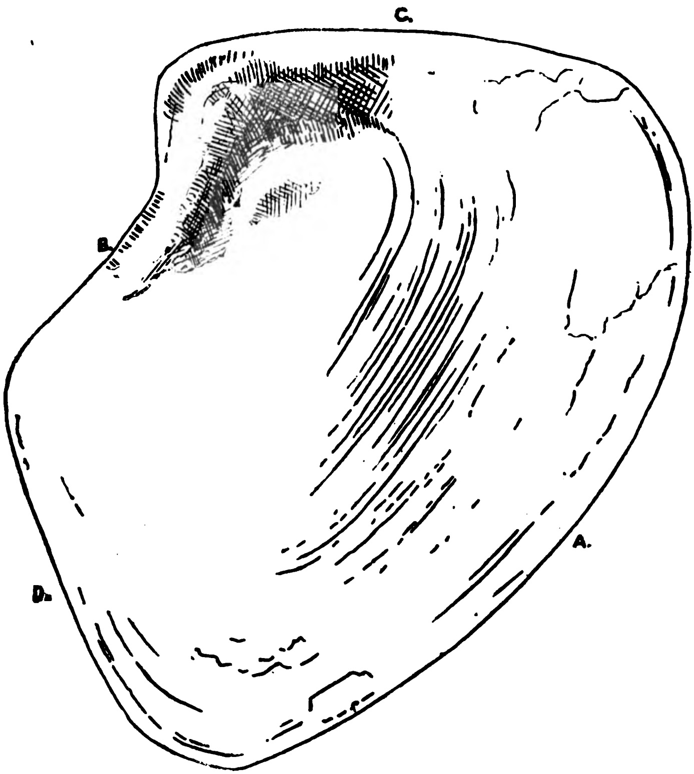
TROCHONEMA UMBILICATUM.

Pleurotomaria umbilicata, Hall. 1847. Pal. St. N. York, vol. I, pp. 43 and 175, pls. x, figs. 9 a–b, & xxxviii, figs. 1 a–g.
Trochonema umbilicatum, Salter. 1859. Geol. Surv. Can., Can. Org. Rem., Dec. 1, p. 27, pl. vi, fig. 3.
" " Billings. 1863. Geol. Canada, p. 145, fig. 92.

The Dog's Head, Lake Winnipeg, T. C. Weston, 1884: one specimen. Snake Island (one specimen) and Berens Island (one specimen), Lake Winnipeg, Messrs. Dowling and Lambe, 1890. Commissioners Island (one specimen) and Reindeer Island (one specimen, loose), Lake Winnipeg, D. B. Dowling, 1890.

MACLUREA MANITOBENSIS

Maclurea Manitobensis, Whiteaves. 1890. Trans. Roy. Soc. Canada, vol. VII, Sect. 4, p. 75, pls. xii, & xiii, figs. 1 and 2.



Maclurea Manitobensis.—Inner side of an operculum, supposed to be that of a large specimen of this species, from Jack Fish Island, Lake Winnipeg. Natural size.

All the localities at which this species had been found, up to the close of 1889, are enumerated in the paper in which it was described. Since then it has been collected by Messrs. Dowling and Lambe in 1890 at Berens Island, at Sturgeon, Snake and Black Bear islands, Lake Winnipeg; by Mr. Lambe in 1890 at the Dog's Head; and by Mr. Dowling in 1891 at Commissioners, Little Tamarack and Punk Islands, also at Grindstone Point, Lake Winnipeg. It is one of the most abundant and characteristic fossils of the Trenton limestone of Manitoba, and according to Messrs. Weston, Tyrrell, Dowling and Lambe, it always occurs with the flat side uppermost in the rock.

In 1890 Mr. Lambe collected an operculum, which is probably that of a large specimen of this species at Jack Fish Island, Lake Winnipeg. This operculum, which is represented in outline in the wood cut on page 324, is a little more than four inches in height or depth, and not quite three inches in its maximum breadth. Its outer surface is completely buried in the matrix, the inner surface only being exposed. In the woodcut, the side indicated by the letter A clearly corresponds to the outer side of the shell, and the concave side opposite,—B,—to the inner or columellar side. The side marked C corresponds to the flattened spiral side of the shell, and that marked D to the inner wall of the umbilicus. The margins of the sides C and B, whose junction forms the "nuclear angle," are thickened, but the edges of the other two sides are very thin. This thickening of the sides C and B is immediately followed by a shallow depression in the nuclear region, but the inner side of the operculum is otherwise nearly flat. The surface markings of this side consist of numerous concentric raised lines of growth, but there are no clear indications of any "internal projections for the attachment of muscles." Although the opercula of *M. Logani*, Salter, and *M. crenulata*, Billings, are known to be provided with well developed muscular processes on the inner side, this is by no means always the case in other

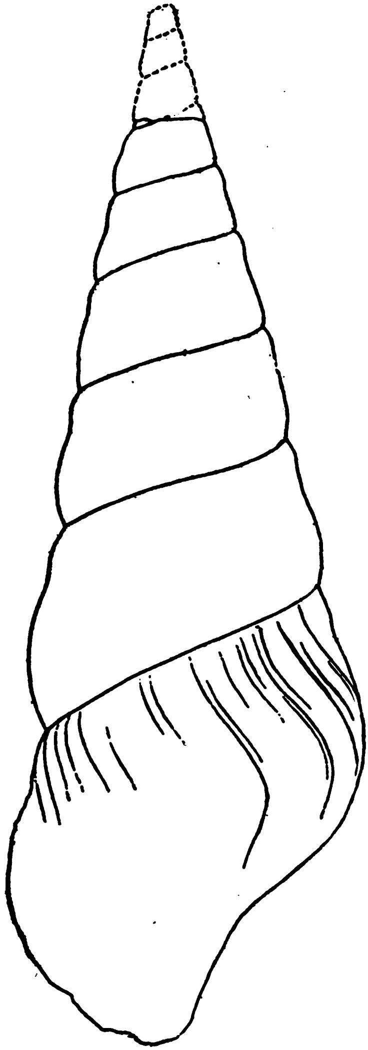
species of the genus. On page 238 of the first volume of the "Palæozoic Fossils" of Canada, E. Billings distinctly states that there are no muscular processes on the inner side of the operculum of his *M. oceana*, and on page 243 of the same volume he figures opercula of two other species of *Maclurea*, from Cape Norman, Newfoundland, in which there are no muscular processes on that side. In the Museum of the Geological Survey at Ottawa, there are two opercula from the Calciferous of the Mingan Islands, which were referred by E. Billings, with some doubt, to the *M. matutina* of Hall. There are no processes on the inner side of these opercula.

LOXONEMA WINNIPEGENSE. (Sp. nov.)

Shell large, attaining to a length of upwards of five inches, terebriform, elongated and nearly three times as long as broad: spire, as measured on the dorsal side, occupying not quite two-thirds the entire length: apical angle 27°. Volutions ten, allowing for the apical one, which is broken off in all the specimens collected, increasing slowly in size and obliquely compressed, the later ones slightly constricted above and moderately inflated below, those of the spire much broader than high: suture distinctly compressed: outer or last volution a little higher than broad, moderately convex but scarcely ventricose in the middle and narrowing abruptly into the somewhat pointed base.

Surface of the spire nearly smooth, that of the last volution marked only with a few flexuous lines of growth, which curve gently and concavely backward above, and still more gently forward below.

Four fine large specimens of this species, each with nearly the whole of the test preserved, have been collected at as many different localities on or in Lake Winnipeg. Two of these specimens were collected by Mr. Weston in 1884, one at Stony Point and one at Jack Fish Bay; one by Mr. Tyrrell in 1889 at Berens Island; and one by Mr. Dowling in 1891 at the "Dog's Head."



Loxonema Winnipegense.—Dorsal view of a specimen from Stony Point, Lake Winnipeg, in outline only, and of the natural size.

Nine volutions are preserved in the most perfect of these specimens, the slender apex of each being broken off. In the perfect shell there must have been at least ten and probably as many as eleven volutions. The species is of considerable interest on account of its strikingly close similarity to some of the most typical Jurassic species of *Pseudomelania.*

FUSISPIRA VENTRICOSA.

Fusispira ventricosa, Hall. 1871. Twenty-fourth Rep. N.Y. St. Mus. Nat. Hist., p. 229, pl. viii, fig. 6.
" " Whitfield. 1882. Geol. Wiscons., vol. IV, p. 245, pl. ix, fig, 2.
" " Miller. 1889, N. Am. Geol. and Palæont., p. 405 fig. 676.

Abundant at many of the limestone exposures on the western shore of Lake Winnipeg and on the islands in that lake. It has been collected by Mr. Weston in 1884 at Lower Fort Garry; at Bull's Head, the Dog's Head, Big Grindstone Point, Big and Elk Islands: by Mr. Tyrrell in 1889, at Berens Island; by Messrs. Dowling and Lambe in 1890, at Berens, Snake and Black Bear Islands; by Mr. Dowling in 1890 at Commissioners and Punk Islands; and by Mr. Lambe in the same year at the Dog's Head.

OTTAWA, March 22nd, 1893.

SOME MISCONCEPTIONS CONCERNING ASBESTOS.

By J. T. DONALD, M.A.

(*Abstract of a paper read before the Natural History Society, Montreal, Feb. 27th*, 1893.)

During the past decade the uses of asbestos have become widely extended, and been consequently brought to the knowledge of the great majority of those who live within range of our industrial centres. As a result of the wide applications of this substance and of the interest excited in the minds of many by a "stone" which may be teased out into

a fluffy mass resembling silk or cotton, there has arisen a somewhat extensive literature of asbestos. This is scattered through geological, chemical, technical and even religious publications, and there have appeared one or two not unpretentious volumes devoted entirely to this mineral. In this literature there are frequent statements which clearly indicate that some of the writers entertained serious misconceptions concerning asbestos, and to call attention to a few of these is the object of this paper.

I. There is a misconception as to the mineralogical character of asbestos, and this has arisen from the use of the name in a somewhat generic sense. Dana in his "Mineralogy," says that asbestos is a finely fibrous form of hornblende, but much that is so-called is fibrous serpentine. This statement seems to divide many of our writers into two camps, the one calling the mineral a variety of hornblende, the other proclaiming its serpentinous character.

The Canadian Province of Quebec produces, it is estimated, about 85 % of the world's supply, the balance coming principally from Italy. The products of these two countries are known the world over as asbestos, and it is not unreasonable, therefore, to ask that they be allowed to appropriate the name, even though they be of other composition than the mineral to which mineralogists originally applied the term, and that other minerals, if such there be, used for similar purposes be otherwise designated.

The asbestos of commerce is a hydrated magnesian silicate of the same composition as ordinary serpentine rock; in other words, it is fibrous serpentine. It is curious to note, however, that the Canadian miners working continually among serpentine and nothing else, have fallen upon the word hornblende and apply it to very coarsely fibrous and polished serpentine, such as is often met with along lines of faulting.

II. The second misconception is in reality but a special case of the first; it is to the effect that Canadian and Italian asbestos are different minerals. In the early days of the asbestos industry, Italy was the only source of supply, and

immediately prior to the discovery of the Canadian deposits a powerful company had been formed and had succeeded in bringing under one control the numerous small mines of the Italian district.

Under the circumstances it is not to be wondered at that the Canadian fiber found no favor in the eyes of the owners of the Italian mines. The Canadian mineral was declared to be far inferior to the Italian; the latter, it was maintained, is true asbestos, while the former is only fibrous serpentine. As a matter of fact the two minerals are practically of the same composition, as is shown by the following results of analysis of fair samples recently made by myself:—

Italian.		Canadian.	
Silica	40.30	Silica	40.57
Magnesia	43.37	Magnesia	41.50
Ferrous Oxide	.87	Ferrous Oxide	2.81
Alumina	2.27	Alumina	.90
Water	13.72	Water	13.55
Total	100.53	Total	99.33

Canadian asbestos has largely displaced the Italian, not because of difference in composition, but by reason of the greater ease with which the former can be wrought into the various forms required in the arts.

III. The third misconception is that asbestos is in nowise affected by heat. This is set forth in such statements as "temperatures of 2,000° to 3,000° are easily withstood," and "a mineral which has been successfully exposed to a heat of 4,500° to 5,000° Fahr."

Now, what are the facts of the case? It is true that asbestos is infusible except at very high temperatures, but it is equally true that only a very moderate degree of heat, heating to low redness in a platinum crucible for instance, is required to entirely destroy the flexibility of the fibre and render it so brittle that it may be crumbled between thumb and finger as readily as a piece of biscuit. In this connection one is reminded that the ancients are said to

have possessed asbestos napkins which they cleansed by means of fire, and that Charlemagne in like manner cleansed his tablecloth to the delight of his warrior guests. It is not improbable that these statements are to a large extent mythical; certainly, if true, the articles in question were not made of asbestos, the HYDRATED magnesian silicate.

IV. The fourth misconception is that asbestos is possessed of non-conducting qualities. This is perhaps the gravest and most widely spread of the several misconceptions and is held by many who should know better. As an example of the manner in which this last misconception is set forth, I may cite the following from an address of a well known geologist: "Among the most important properties of asbestos is that of non-conductivity or its power of resisting the action of heat." Here we have the misconception clearly stated; it is that because asbestos is infusible it must of necessity be a good non-conductor. The truth is that asbestos itself is a very poor non-conductor, as any one may prove by placing a vessel of water on a sheet of asbestos cardboard and applying heat from below, or more simply still by placing a piece of wood or a sheet of asbestos millboard on a hot stove. If, however, asbestos is teased out and worked into a fluffy mass we then obtain a non-conducting material, but it is the air inclosed by the fibres that is the real non-conductor, the asbestos serving simply to entangle the air. The use of asbestos in the manufacture of non-conducting coverings for boilers, etc., is due to its fibrous texture and its infusibility. The latter property gives it a decided advantage over hair and other fibrous materials which char under continued exposure to heat, while the exceeding flexibility of its fibres gives it a like decided advantage over mineral wool and other fibrous but brittle mineral substances.

The removal of the misconceptions to which attention has been called, will in no respect tend to decrease the uses of asbestos, for the mineral has a sufficiency of good quality of its own to maintain and increase the demand; while, on the other hand, a true conception of its nature and proper-

ties will prevent its use under conditions where only disappointments can follow; a circumstance which in the end would tend to bring discredit upon a most valuable mineral.

The Folk-Lore of Plants.

By Carrie M. Derick, B.A.

The subject of plant-lore has been so admirably treated by Thistleton Dyer and others, that it would be difficult to present anything fresh in a paper such as this, without more time for investigation than the writer has at her disposal. Some pains, however, have been taken to arrange in brief form bits of folk-lore distinctively American as of especial interest to Canadians.

The early settlers seem to have been too much occupied with the practical side of life to weave new fancies about the primeval forest. Therefore, while some of our fables are indigenous, the majority of our common plant names and superstitions are heirlooms from our European ancestors. But there is a rich field for discovery awaiting the patient investigator, in the beliefs of the American Indians and the poetic fancies of the French Canadian people.

"To the Indian the material world is sentient and intelligent. A mysterious and inexplicable power resides in inanimate things. In the silence of a forest, is a living majesty, indefinite but redoubtable. Through all the works of nature nothing exists that may not be endowed with a secret power for blessing or for bane."[1] The Indian, in common with other uncultured men, observing that plants as well as man possessed the phenomena of life and death, endowed each with a soul like his own, and regarded it with simple reverence. So, we learn, that the Ojibwés hesitated to cut down trees lest they should hear them wailing in their suffering.

Closely allied to this idea of spiritual vitality was the wide-spread belief that plants were the homes of deities. Schoolcraft mentions an Indian tribe who fancied they

[1] Parkman's *The Jesuits in North America.*

heard, on calm days, a sound like the voice of a spirit speaking to men, issuing from the recesses of a certain tree. They, therefore, thought it the abode of a powerful divinity and held the tree sacred.

The influence of the doctrine of the transmigration of souls long continued in the notion that the spirits of the departed took up their abode in plants. Classical and mediæval literature furnish many beautiful illustrations, and a similar idea prevailed among savage nations. Thus, "some of the North-Western Indians believed that those who died a natural death would be compelled to dwell among the branches of tall trees." "Among the Virginian tribes, red clover was supposed to have sprung from and to be coloured by the blood of red men slain in battle.'[1] In certain parts of Canada, it is still thought that wherever Sanguinaria canadensis grows in the woods an Indian has been buried, and that the red juice of the plant is the dead man's blood.[2] The Ojibwé legend of Mondamin, which has been beautified and extended by Longfellow, furnishes another illustration. Mondamin comes from the sky as a handsome youth in garments green and yellow, and struggles with Hiawatha at his "fast of virility." At last Mondamin is overcome and laid in his grave.

"Day by day did Hiawatha
Go to wait and watch beside it,
Kept the dark mould soft above it,
Kept it clean from weeds and insects,
Drove away with shouts and shoutings,
Kahahgee, the king of ravens.
Till at length a small green feather
From the earth shot slowly upward,
Then another and another,
And before the summer ended
Stood the Maize in all its beauty,
With its shining robes about it,
And its long, soft, yellow tresses."

[1] Dyer's Folk-Lore of Plants.

[2] Ghost Worship and Tree Worship, by Grant Allan. Pop. Sci. Monthly, Feb., 1893.

A wide spread superstition among the Algonquins, due to such superstitious ideas as the above, is that the tales must not be told in summer, since "at that season, when all nature is full of life, the spirits are awake, and hearing what is said of them, may take offence, whereas in winter they are fast sealed up in snow and ice, and no longer capable of listening."[1]

As a natural consequence of this animistic theory, which endowed trees with souls, or of the once wide-spread custom of ancestor worship, in the agricultural stage of all primitive peoples, plant worship was an important feature of religion. Grant Allan says, at the dawn of history, men poured libations and scattered fruits upon the graves of their dead. As a result the barrows displayed a most luxuriant vegetation. Knowing nothing of the cause of fertility primitive man attributed it to the spirits of the dead, and transferred the worship of the ancestor to tree or flower. Formerly, according to Charlevoix, "the Indians in the neighborhood of Acadia had in their country, near the sea shore, a tree extremely ancient, of which they relate many wonders, and which was always laden with offerings. After the sea had laid open its whole root, it supported itself a long time, almost in the air, against the violence of the wind and the waves, which confirmed those Indians in the notion that the tree must be the abode of some powerful spirit. Nor was its fall, even, capable of undeceiving them, so that as long as the smallest part of its branches appeared above the water, they paid it the same honour as whilst it stood."

There has ever been in men's minds the idea of the antagonism of good and evil. So plants were supposed to be the abodes, not of beneficent beings only, but of demons. Sometimes, poisonous or repulsive plants were thus devoted, but no rule seems to have decided the matter. Many of our common names at the present day associate certain plants with his Satanic Majesty. In the Eastern Townships,

[1] *The Jesuits in North America.*

Nigella Damascena is called devil-in-a-bush, and certain species of Lycoperdon are his snuff-box. Along onr coasts *Laminaria longicruris* supplies the devil with aprons, and in various parts, *Clematis virginiana* is known as devil's darning-needles. Mrs. Bergen says that in Ohio and New England children call *Aplectrum hyemale* "Adam and Eve." When this somewhat rare plant has been found, they immediately begin to look around for the "devil," as they call the third leaf which is frequently seen near by, it probably being a new plantlet sent up from a root stock.[1]

Much prettier are the superstitions which associate flowers and fairies. Their dainty brightness seems foreign to the Indian character, but in our country districts children still adhere to many of the fanciful ideas of their forefathers. Bright green rings of grass are to them "fairy rings," within which "the little folk" hold midnight revels, feasting on fairy cheeses, (*Malva rotundifolia*) off mushroom tables, the company having been summoned by the gay jingle of "fairy bells," (*Oxalis acetosella.*)

The belief in the supernatural character of plants is fast dying out, but, even in this rational age, some are considered effective charms and are consulted in playful divination. Children, especially, have quick eyes for the marvellous, and accept, readily, any notion once formulated. In Clarenceville, P.Q., children pull a dandelion, which has gone to seed, and blow the feathery head to see if their mothers wish them to go home. They also tell the hour by counting the number of times it is necessary to blow the dandelion before removing all the achenes.

This is referred to in:

"Dandelion with globe of down,
The school boy's clock in every town,
Which the truant puffs amain
To conjure lost hours back again."

A favorite amusement in every place, is to hold a butter-cup under the chin to see if one "loves butter" or no.

[1] The Animal and Plant Lore of Children, by Mrs. Bergen. Pop. Sci. M., vol. 29.

Love-charms have a never-failing interest for many. The formula repeated, while the charm is used, being more essential than the flower chosen. In New Brunswick, on St. Agnes Eve, rosemary is placed under the pillow with these words:—

"St Agnes, that's to lovers kind,
Come ease the troubles of my mind."

The lovers of the girl, trying the charm, will then appear to her in a dream. The well-known European practice of ascertaining a lover's sincerity by plucking, one by one, the rays of a daisy, at the same time repeating a rhyme, has a slight variation in New Brunswick. The usual formula being often replaced by:—

"He loves me, he don't,
He'll have me, he won't,
He would if he could,
But he can't."

Bad English does not interfere with the efficacy of a charm. "Peascod wooing" is practised in various parts of Canada. If when shelling peas, the cook chances to find a pod containing nine, she places it over the door. The first man who enters will bear the same name as her future husband. In Campbellton, N.B., it is customary for a girl to gather three or four heads of thistle, cut off the purple tips, assign to each head the name of an admirer, and place them under her pillow. The next morning, the thistle which has put forth a fresh sprout will show which is the truest of her lovers.

Among North American Indians, dreams and trees have a close connection. The Ojibwés believe in a mysterious tree or vine which forms a link between earth and heaven. Upon it, spirits habitually pass up and down; but in dreams only, were men enabled to climb it and gain an insight into the future.[1]

The weather, apart from its physical effects, was supposed to have a great influence over plants. Each was

[1] Dorman's Primitive Superstitions.

under a certain "sign." Even yet, in rural districts, respect is paid to the phases of the moon, when planting and sowing crops. Root crops, which have their edible portions beneath the soil, should be "put in during the wane of the moon or 'in the sinking sign,' in contradistinction to 'the rising signs' which were those of the rising orb." "Plant corn when the little moon, i.e. the new moon, points down, the ears will then grow low on the stocks and be heavy." "All Fridays are good days for planting things that hang down, like beans or grapes, i.e. stringy things, for Friday is hangman's day." [1]

The study of the popular names of plants is most fruitful and interesting. "The fascination of plant names has its origin in two instincts, love of nature and curiosity about language. Plant names are often of the highest antiquity, and more or less common to the whole stream of related nations. Could we penetrate to the original suggestive idea that called forth the name, it would bring valuable information about the first openings of the human mind towards nature." [2] Though several have been noticed in other connections, a few of our popular American plant names may be mentioned, as illustrations of how much there may be in a name. Many flowers have, at some time, been dedicated to heathen divinity or Christian saint, and still bear their names. The Virgin Mary has been especially honoured, and various plants, from more or less fanciful resemblances, furnish her with an extensive wardrobe. For example, two flowers, the cypripedium and *Impatiens fulva* supply the slippers, the fuchsia blossoms are her ear-drops, while the campanula is her looking-glass. The Puritan element is evident in several names of flowers, *Aquilegia canadensis* being sometimes called "meeting-houses," and *Houstonia cærulea,* "quaker-ladies." A distinctively American name is that of "White man's foot"

[1] N. C. Noke in the Jour. Am. Folk-Lore, June, 1892.

[2] Earle's English Plant Names.

(*Plantago major*). The Indians, believing it followed in the steps of white men, so named it.

> "Whereso'er they tread, beneath them,
> Springs a flower unknown amongst us,
> Springs the white man's foot in blossom."

In Clarenceville, P.Q., Rudbeckia hirta is called "nigger-heads," a name which originated in the South-Western States.

Children's games and fancies have given rise to peculiar local names. In New Brunswick, *Viola tricolor* is called "old man" from its resemblance to an old man with his feet in a bath-tub. In Clarenceville, P.Q., *Viola cucullata* is known as "roosters," a favourite game with children being a bloodless battle between two violets. The one, which preserves its blossoms during the struggle, is pronounced the victor. The appearance of the plant itself or the use to which it is put explains such names as "butter-and-eggs" (*Linaria vulgaris*), crane's-bill (*Geranium Robertianum*), Jack-in-the-pulpit (*Arisæma triphyllum*), ghost-flower (*Monotropa uniflora*), face-and-eye-berries (*Juniperus sabina*), and dyer's weed (*Reseda luteola.*)

American folk-lore is eminently practical and largely made up of superstitions relating to folk-medicine. "The doctrine of signatures," which is the old theory that "plants, by their external character, indicated the disease they were intended to cure," has its adherents, at the present day. Doubtless, some of the plants used in old medicine had useful remedial properties but the majority owed their popularity to mystic virtues. One of Miss Wilkins' pretty stories takes its name "Life Everlasting," from the fancy that a pillow of the flowers of *Gnaphalium polycephalum* will cure asthma. The practice of carrying a potato in the pocket, as a charm against rheumatism is common. In New Brunswick, a double cedar knot serves the same purpose. Pliny says that snakes will sooner go through fire than creep over ash leaves or into the shadow of an ash-tree.[1] Even yet, in the United

[1] See Culpeper's *Herbal;* and Fiske's *Myths and Myth-Makers.*

States, many consider ash leaves a cure for the bite of a rattlesnake. Dr. Holmes uses this superstition effectively, in one of the closing scenes of "Elsie Venner." Elsie, who was supposed to have had engrafted upon her womanly nature that of a rattlesnake, received a basket of autumn flowers, the lining of the basket being the leaflets of the white ash. "She took out the flowers, one by one, her breathing growing hurried, her eyes staring, her hands trembling,—till, as she came near the bottom of the basket, she flung out all the rest with a hasty movement, looked upon the olive-purple leaflets as if paralyzed for a moment, shrunk up as it were, into herself, in a curdling terror, dashed the basket from her, and fell back senseless, with a faint cry which chilled the blood of the startled listeners." Mrs. Bergen states that in Portland and Boston it is thought that children, when teething, should wear a string of the seeds of Job's tears (*Coix lachryma.*) They are sold in Peabody, Massachusetts for sore-throat and diphtheria, as well. One mother "triumphantly brought to a druggist of whom she had bought them a string of these seeds covered with a dark incrustation which she identified as the substance of the disease driven out into the necklace, but which to the apothecary bore a strong resemblance to dirt." [1] Everyone who passed his childhood in the country, will recall many such remedies; the virtues of "sassprilla," "skunk cabbage," "goold-thread," and other "yarbs," being almost universally recognized, in places somewhat removed from the centres of civilization. Early superstitions are rapidly vanishing before the light of modern science, and all should record at once any legend or peculiarity met with, before it is too late, for in them lies much of the history of our people; its national legends are often the only immortal possession of a race.

[1] Some Bits of Plant-Lore, Jour. Am. Folk-Lore, March 1892.

The Late Dr. John Strong Newberry.

The United States has lost one of its ablest geological workers, in the death of Dr. Newberry. Born in 1822, and having first appeared as a scientific investigator and writer in 1851, he may be regarded as one of the senior scientific men of the Union, and few have worked more diligently and assiduously, or on a greater variety of subjects.

Personally, Newberry was frank, kindly, generous and upright; and beloved by those who had the honour of his acquaintance. His early papers on the fossil plants and fossil fishes of the Carboniferous established his reputation as a palæontologist, and were followed by a long series of reports and papers on these subjects, all done with conscientious care, and of the highest scientific value. Later, he worked with much success at the mesosoic and tertiary floras; and laid foundations in these departments which others have built on. As a physical geologist his Colorado reports and his later work in Ohio, have given him a wide reputation; and in these explorations he evinced a power of inductive reasoning and a grasp of the various phenomena observed, of a very uncommon character. While thus eminent in scientific geology, he was willing to give the benefit of his knowledge to the development of the mineral resources of his country, and he rejoiced in any opportunity to popularize the subjects of his studies in lectures and magazine articles, and he was a leading mind in the teaching work of the School of Mines of Columbia College, New York. The following notice in "Nature," is probably from the pen of the distinguished head of the Geological Survey of Great Britain; and may serve to show the estimation in which he was held beyond the limits of his native country.

J. W. D.

"It is not only in the United States that the death of this veteran of scientific research will bring widespread regret. To many geologists and palæontologists in this country and on the Continent he was personally known, and those whom he honoured with his friendship will feel keenly the

loss they now sustain. He was born at New Windsor, Connecticut, on December 22, 1822, and took the degree of M.D. from the Cleveland Medical College, Ohio, in 1848. Before beginning the practice of medicine, which he intended to be his occupation in life, he spent two years in Europe. During his stay at that time in Paris he acquired a good knowledge of the French language, and had many opportunities of cultivating a love of science, which soon manifested itself as one of his distinguishing characteristics. Returning to his native country, he began practice as a medical man at Cleveland in 1851. Even at the outset of his professional work he contrived to find time also for scientific enquiry. His first published paper appeared in the same year in which he started in his medical profession. It is devoted to the geographical distribution of land and fresh-water shells.

"But he soon entered upon the two branches of geological investigation in which he was to make his name familiar all over the civilized world—the study of fossil botany and of fossil fishes. As early as the year 1853 he made his first contribution to the history of Carboniferous plants, and three years later his earliest memoir on fossil fishes was published. By this time his scientific acquirements and enthusiasm were widely known. Hence when an expedition under Lieutenant Ives was organized for the exploration of the Colorado River of the West, Newberry was selected to accompany it, and to take charge of the observations to be made in natural history. His geological contribution to the famous Report at once placed him in the very front rank of American geology. His account of the geological structure of the region traversed by the expedition, and of the marvellous denudation of the cañons, will always remain as one of the landmarks of geological progress.

"He had now been touched by the fascination of exploration in the far west. The drudgery of medical practice became irksome to him, so that when in the year following his return from Colorado the offer was made to him to take part in another expedition, he gladly availed himself of

the opportunity. He accordingly accompanied Captain Macomb in an exploring expedition in the summer of 1859, from Santa Fé, New Mexico, to the junction of the Grand and Green Rivers of the Grand Colorado. This journey forms the subject of another masterly report by him, which, however, was not published for some sixteen years.

"The shadows of the coming great Civil War were already falling on the United States, when Newberry was at work on the preparation of the record of the results of his western journeys. The storm at last burst in 1861, the same year in which his Colorado report was issued. Among the many scientific men who placed their services at the disposal of the North, Newberry took a foremost place. His medical skill and wide general scientific knowledge enabled him to be of great use to the army. He specially distinguished himself in the organization and administration of the hospital department. Among the reminiscences of his not uneventful life he had many graphic tales to tell of his experience during that momentous epoch in the history of the United States. After the close of the war in 1865 he returned with renewed ardour to his scientific labours, and specially devoted his energies to the study of the ancient floras and fish-faunas of North America. Among his numerous memoirs on these subjects the two large monographs forming vols. xiv. and xvi. of the series published by the United States Geological Survey are specially worthy of notice. But they represent only a part of the enormous mass of material which he had worked over.

"Prof. Newberry early in his career saw how great was the aid which geology could afford in the development of the mineral industries of his native country, and he gave himself with great energy to the practical applications of the science. He became one of the highest authorities on mining matters in the country, and he was mainly instrumental in the equipment of the great mining school of Columbia College, New York. He occupied the Chair of Geology in that establishment, and threw himself heart and soul into its duties. At last, in the midst of his work and

honours, a stroke of paralysis disabled him from active duties, and he grew gradually feebler until his death. With him American science loses one of its most honoured and distinguished cultivators. His piercing eyes and well-cut features made him a marked figure in any assembly, while his courtesy and gentleness, and his unfailing helpfulness and serenity, gave him a charm which will endear his memory to a wide circle of friends. A. G."

THE ROCKS OF CLEAR LAKE NEAR SUDBURY.

By Prof. Coleman, Ph.D.

An exceedingly interesting set of rocks from the Sudbury district has been described by Prof. Bonney[1] and Prof. Williams,[2] and it seems worth while to compare with them a series of specimens collected last summer by the present writer in a part of the region not hitherto worked over. The point visited lies about 17 miles north of Sudbury in the area marked Laurentian on Dr. Bell's map,[3] and was reached from Chelmsford, a village ten miles west of Sudbury, on the main line of the Canadian Pacific Railway.

The rocks observed up to the crossing of Vermilion River, belong to the series colored on Dr. Bell's very useful map as "dark argillaceous and gritty sandstones with shaly bands, possibly lower Cambrian." Among the specimens obtained were dark sandstones of the kind described by Dr. Bell, having as constituents weathered felspars, mica and quartz of the granitic type, showing their origin from granite or gneiss. Other ridges were of dark grey clay-slates with a marked cleavage crossing the very distinct planes of stratification obliquely, and presenting under the microscope no distinct minerals except sericite and minute prisms of a uniaxial mineral, perhaps rutile.

[1] Quart. Journ. Geol. Soc., Vol. 44.

[2] Notes on the Microscopical Character of Rocks from the Sudbury Mining District, an appendix to Dr. Bell's report.

[3] Report on the Sudbury Mining District, by Dr. R. Bell, 1891.

North of Vermilion River, near Booth and Hales' lumber camp, examples were obtained of the remarkable black volcanic breccias described by Dr. Bell and the two distinguished petrographers before mentioned. Prof. Williams describes under the name of a vitrophyre tuff[1] specimens enclosing angular fragments of glass or pumice, turned into chalcedony, or a mosaic of small quartz individuals, or sometimes a greenish mineral or even a calcite individual.

In some of my sections enclosed fragments have been turned into a brownish green substance with faint double refraction, probably serpentine, but possibly chlorite. Other fragments are now made up of radiating crystals of epidote. One large white fragment turns out to be a microgranite consisting of quartz, orthoclase, microperthite and plagioclase with a little serpentine. Still other enclosures are of clear quartz individuals, at times with hexagonal outlines. The fluidal and vesicular structure of many of the fragments corresponds exactly with Prof. Williams' description and figure.

East of the lumber camp and south of Clear Lake gabbro makes its appearance, fine grained and dark green on fresh surfaces, but weathering to pale greenish grey when free from sulphides, and to various tones of brown when charged with them. This rock differs greatly from the green diabase, etc., found nearer Sudbury. In most thin sections the felspars are not lath-shaped, but have short idiomorphic forms, sometimes apparently of a single individual or in halves like Carlsbad twins, but generally showing several twin lamellae. The angle of extinction from the twin plane is generally large, 25° or 30°, but at times only 5° or 10°. No analysis was made to determine the presence or absence of orthoclase. The other minerals are chiefly varieties of pyroxene, especially diallage and enstatite, greatly weathered to greenish chloritic products, which have frequently been deposited between the felspars. Large stout crystals of apatite occur in one thin section, and pyrrhotite forms a large part of some specimens. An

[1] Sudbury Mining District, p. 74, etc.

analysis of the pure pyrrhotite gave 4·22 per cent. nickel and 0·21 per cent. copper.

Near the gabbro a rock occurs which, to the naked eye, appears to be a syenite, a flesh colored or dark yellowish grey rock sometimes appearing quite massive, at others splitting into thin plates. Under the microscope it proves to be a micropegmatite much like that described by Prof. Williams from the township of Levak,[1] although the nucleus from which the granophyre structure radiates is in my sections generally a crystal or group of crystals of plagioclase instead of a Carlsbad twin of orthoclase.

A very similar structure is described and figured in photo-reproductions by Julius Romberg from South American granites.[2] He holds that the structure has been caused by weathering of the felspar, at times aided by the plasticity of quartz under intense pressure; as though canals could be formed in this way and plastic quartz forced into them. My specimens afford no support to such a theory but rather seem to show that small crystals of plagioclase or orthoclase or groups of crystals formed nuclei about which the very acid magma solidified as quartz and orthoclase on all sides at once, each hampering the other and thus giving rise to the granophyre structure. In the freshest slide examined the nuclear crystals are quite sharp edged and unweathered in appearance. In most cases all the quartz and all the felspar about a given centre are similarly oriented, though opposite sides sometimes differ in this respect; and the felspar, which is unstriated as a rule, is not generally continuous with the central crystal. If the structure results from weathering or pressure, why should the nuclei have distinct crystalline outlines and the orientation be uniform in the quartz, which, if forced in while plastic should show irregular orientation or a chalcedonic structure? In some instances the quartz increases in amount as it runs outwards and forms solid masses outside

[1] Sudbury Mining District, p. 78.

[2] Neues Jahrbuch für Min. Geol., etc., VIII Beilage Band, Zweites Heft, 1892, p. 314.

the pegmatitic portion, filling in angles between other minerals and proving that quartz was on the whole latest in crystallizing.

As a result of the visit to the Clear Lake region it is found that the band of eruptive rock represented on Dr. Bell's map as extending from the middle of Morgan Township to the northeast corner of Lumsden, and extended in the map published by the Ontario Bureau of Mines in 1892 nearly to the western boundary of the District of Nipissing, should be still extended four miles eastward so as to pass between Clear Lake and Marion Lake which lies to the south.

Notes from the Chemical Laboratory, Queen's University.

Communicated by Prof. W. L. Goodwin.

I.

A Highly Nickeliferous Pyrite.

There is at the Murray Mine, Sudbury, Ontario, a deposit of nickel ore consisting of rounded nodules in a hornblendic matrix. It is found near the surface, and is quarried out along with pyrrhotite, chalcopyrite and galena. In the same deposit is found a pyrite containing no nickel or cobalt; and in an underground working magnetite is found. This also contains neither nickel nor cobalt. The hornblendic gangue is much decomposed at the surface, so that large lumps of the rock fall to pieces with a light blow of the hammer, revealing the nickel ore as grey nodules, resembling in colour and lustre arsenopyrite. It is, however, free from arsenic. Its hardness was found to be 6·5. It was found difficult to separate the pyrite completely from gangue; but an analysis was made of as pure a sample as could be obtained, with the following results:

	I.		II.
Iron......................	37·45	p. c.	....
Nickel (and Cobalt?)	4·82	"	....
Sulphur.......	44·26	"	44·13
Insoluble.................	9·92	"	9·90
	96·45		

The powdered mineral dissolved to a small extent only in hydrochloric acid; but it was evident that there was some appreciable quantity of iron compounds soluble in that substance. This iron doubtless belongs to the black matrix. The 37·45 parts of iron would require 42·80 parts of sulphur for $Fe\ S_2$. This would seem to indicate a lower state of combination for the nickel. But if the nickel is calculated as $Ni\ S_2$, the remaining sulphur requires 34·12 of iron for $Fe\ S_2$. It is not unreasonable to suppose that the iron in excess of this (3·33 p. c.) was derived from the hornblendic matrix, and from particles of magnetite and pyrrhotite.

The analysis was made by Prof. W. Nicol, Mr. T. L. Walker, and the writer. Mr. Walker, formerly chemist at the Murray Mine, Sudbury, has made repeated assays of this nickel ore, and the analysis here given is concordant with his assays. The nickel and cobalt were not separated, but the indications were that the latter is present in small proportion if not altogether absent.

Carruthers Hall, Queen's University, March 29th, 1893.

Is the Fauna Called "Primordeal" the Most Ancient Fauna?

By G. F. Matthew, M.A., F.R.S.C.

Under the above title Dr. J. Bergeron discusses the claim of the Primordeal Fauna of Barrande to be considered the oldest assemblage of animals that has existed on the earth. This is the fauna which characterises the Cambrian rocks (as now understood), and which for a long time was claimed to be the oldest that has existed on the earth.

Dr. Bergeron thinks differently and cites abundant internal evidence from the fauna itself in favour of his view that there has been an older fauna.

After speaking of the influence which the opinions of Darwin and other evolutionists have had on the interpretation of late discoveries in the Cambrian rocks (especially

in the application of the discoveries in the embryology of recent animals to the interpretation of the primitive forms of the Cambrian seas), he takes the trilobites as the most interesting forms, viewed from the stand point of evolution, as being organisms of the highest type (for that age), because in them the results of evolution are most manifest.

After speaking of the trilobites as Arthropods with a chitinous test, living in the water, breathing by gills, furnished with numerous pairs of thoracic limbs of which some are connected with the jaws and some with the abdomen, he proceeds to give in outline a description of the parts of their bodies and their use in the economy of the creature.

The metamorphosis of the Cambrian trilobites has been shown by Barrande for the genus Sao and by Matthew for the genera Liostracus Ptychoparia and Solenopleura. The three latter exhibit similar series of metamorphosis and so are naturally grouped in the same family. On the other hand the changes in the young of Paradoxides follow an independent line of development, showing that this genus belongs to a different family. "We see then that in the trilobites of the fauna called Primordeal there were already differences in the mode of development; and these differences in the forms of the same group living at the same epoch, correspond certainly to a grade of evolution which is not the same; this compels us to admit that before the time when this trilobite fauna lived, there must have been another from which it proceeded."

Another argument used by Dr. Bergeron is that the size of the front lobe of the glabella in embryonic forms of the early trilobites foreshadowed the genera Paradoxides and Olenellus, which are similarly characterized in the adult stage. However, he thinks that more weight is to be given to the small size of the pygidium in these and other primordeal genera as indicating the primitive aspect of the Cambrian trilobites, for in the embryonic trilobite the pygidium is small compared with the cephalic shield.

The development of the genus Agnostus also is taken as showing the line of change through which the genera of

trilobites were inclined to pass. Tullberg had shown this for the Agnosti of Scandinavia.

The author shows that the earlier forms of Paradoxides were small and the gigantic form *P. Regina* was one of the later. These large species perished suddenly without leaving any successors. The same rule holds for Asaphus and Illanus and large species of other genera.

"The preceding study of the characters peculiar to the trilobites of the Cambrian has led us to the conclusion that these present sure indications of an evolution anterior to the epoch in which they lived. This leads us to think that there must have lived prior to the fauna called primordeal, one which may have contained the ancestral types of the most ancient one that we actually know."

Dr. Bergeron supports this view of the source of the most ancient forms of animals known by an outline of the opinions now held in regard to the metamorphism of the older sediments, by which the proofs that may have existed in the pre-Cambrian rocks of the life of that earlier epoch have been destroyed.

This article by Dr. Bergeron, published in the "Revue Générale des Sciences, Paris, 1892," is an excellent review of the evidence on this subject as based on the latest discoveries in geology.

RADIOLARIAN REMAINS IN THE AZOIC ROCKS OF BRITTANY.

Dr. Chas. Barrois helps to solve the above question of his countryman (Is the fauna called Primordeal the most ancient fauna?) by proclaiming the discovery of Radiolarian remains in the Azoic rocks of Brittany. These he discovered in a graphitic quartzite which constitutes an integral part of the granulitic gneiss of that part of France. The beds have been traced through Vannes and several neighboring towns, where they are less affected by granulitic intrusions, and become a carbonaceous quartzite and shale, and underlie the system called the schists of St. Léo. These schists are considered to be pre-Cambrian, and would correspond to the Huronian system of Canada.

Sections of the carbonaceous shales placed under the microscope show circular or rounded objects of a peculiar aspect; they recall at first view sections of *Radiolarians.* Dr. Barrois submitted sections of this shale (phtanite) for examination by M. Cayeux, who stated that the presence of Radiolarians in these phtanites was undeniable, and one could even refer them to *Monosphæridæ*, the most primitive of the Radiolarians.

"These Radiolarians are the most ancient organic remains found in France, and probably in the world; and the phtanites are at present classed in the Primitive Azoic formation about the limit of the Laurentian and pre Cambrian systems."

By degrees cotemporaries are turning up in the Pre-Cambrian rocks for the once solitary Eozoon. To Walcott's minute molluscs of the Grand Cañon of the Colorado are to be added the Stromatapora-like fossil and the Hexactinellid sponge of the Pre-Cambrian rocks of St. John (Eastern Canada), and now the Radiolarians of Western France.

On Some New Discoveries in the Cambrian Beds of Sweden.

Dr. J. C. Moberg, of Lund, has within the year that is past enlarged the number of species known from the Olenellus Zone of Sweden. In two pamphlets he has described a number of species collected by Dr. N. O. Holst and others, which are of peculiar interest. These are from sandstone boulders and beds in the south of Sweden.

Among the fossils are two new species of Olenellus, one allied to *O.* (*Holmia*) *Kjerulfi*, but differing in the more strongly arched headshield, by having a much heavier cheek-spine, by a deficient (or perhaps rudimentary) interocular spine, by a more lengthened hypostome devoid of spines at the back, etc. This species he calls *O. Lundgreni.*

The second species is allied to *O.* (*Mesonacis*) *Michwitzi*, from which it is distinguished by the arrangement of the glabellar furrows by the form of the outer part of the

pleuræ, by the presence of a small point on each side at the back of the pygidium, etc. This species he calls *O. Torrelli.*

With these two species of Olenellus, Dr. Moberg found a small Lingula?, two Hyolithes and a small Obolella?, and he supposes their geological age to be intermediate between that of *O.* (*H.*) *Kjerulfi* and *O.* (*M.*) *Michwitzi.*

He has found in loose blocks of Cambrian sandstone a brachiopod of which the arched valve is said to resemble the shell of Ancylus. It is marked within by a set of radiating ridges like the supposed operculum of *Hyolithellus micans* and Dr. Moberg revives Dr. Hall's genus *Discinella*, referring his species to it. As it has 14 radiating furrows in place of the 9 or 10 that are found on the form from Troy, N.Y., described by Hall, he considers it specifically distinct, calling it *D. Holsti.*

He very significantly remarks that in the material in which his Discenella was found, one "very seldom finds any fossil which is plainly the living chamber of a pteropod of the type which Billings described under the name of Hyolithellus; and on the other hand one does not find the Discina-like fossil in the material where the reed-shaped or Hyolithus-like fossil is plentiful."

Dr. Moberg describes two species of Kutorgina; one doubtfully as such, having a very peculiar interior. This probably is of some other genus. Other genera described are Acrothele, Obolella?, Scenella??, Dentalium?, Hyolithes, Volborthella?.

G. F. M.

Memphremagog a Cold Water Lake.

By A. T. Drummond.

Lake Memphremagog is the Loch Lomond of Canada, but, being less easy of access from the great cities, does not attract the tourist as does the Scottish lake. It is, however, not less beautiful. From the summit of Owl's Head there is a view that for beauty and breadth is probably

unsurpassed elsewhere in Canada, while at the lake margin there are lovely scenic effects particularly in the evenings when the purple hills are brought into bolder relief by the brilliant tints of the setting sun and are mirrored in the waters of the lake.

Whilst the surrounding mountains and glens have an interest to the botanist, and the whole environs of the lake present to the geologist a peculiar record of the past, the waters of the lake have in their temperatures a feature of interest to which, in a word, I would like to draw attention. Lake Memphremagog has a length of about thirty miles, an area of thirty-seven square miles, and, according to Sir William Logan, a surface level of 756 feet above the level of the sea. Lake Superior, with its cold waters, is in higher latitude but is only 600 feet above the sea level, whilst its deeper depths sink far beneath it. The smaller and shallower lakes are, like the rivers, susceptible to the equalizing influences of summer temperatures, but, in the case of Lake Memphremagog, circumstances peculiar to itself, affect the conditions of heat and cold in its waters. Whilst it is exceptionally high above the sea, it is in many places of considerable depth. Nearly opposite Owl's Head, the sounding line, it is claimed, has reached the depth of 600 feet, whilst near Georgeville, six miles further down the lake, there are places where I have not found the bottom at 325 feet. The opposite shores at this point are about two miles apart, and it was here, about midway across, that last August the temperatures were taken. Negretti & Zambra's deep-sea thermometer was used for ascertaining bottom records. The following register made on 10th of August at 11 a.m. under the conditions of strong sun and cloudless sky, indicates generally the results:

Air in shade	77.5° F.
Water 1″ below surface	74°
do 6 fms. do	57.5°
do 12 do do	51°
do 48 do do	48°
do 54 do do	44.75°

The results establish the two facts,

1. That Lake Memphremagog is a cold water lake whose bottom temperature at 54 fathoms is, in early August, as low as 44.75° F.

2. That the high temperature of the surface at the same period is only maintained for, relatively, a few feet beneath, beyond which the mercury falls rapidly to near the lowest temperature.

At the head of the lake at Newport, the flow of water from the small rivers rising in the Vermont hills, creates a decided surface current past Newport, and although I have not specially endeavored to trace this current onward to the outlet at Magog, it is suggestive from the temperatures that the warm waters from the neighboring rivers and streams flow, river-like, over the colder waters of the lake, just as the Gulf Stream, under a different influence, but lightly skims the surface of a large portion of the broad Atlantic Ocean.

To illustrate the relative temperatures, whilst the thermometer at 12 fathoms here registered 51°, the waters of Lake Ontario, at their outlet into the St. Lawrence, indicated at the same depth, and at about the same period, 67°.

On the Political and Economic Significance of the Small Industries; and their Encouragement by Central-station Power Supply.

By J. T. Nicolson, B.Sc. (Edin.)

I.

One of the greatest questions of the present day, in view of the rapid centralization throughout the civilized world which is now taking place in great industrial cities; is that of the welfare and advancement of the skilled labouring classes. The attention of all who, like the writer, have lived for any length of time among artizans, is irresistibly directed to this matter; and the conclusion that things are far from being satisfactory is forced upon them.

It is the author's belief that the ill conditions of life of the manufacturing classes are responsible for most of the vexatious labour controversies, the political disaffection, and even the widespread Socialism of the present day. The system, which has gradually developed during the last few decades, of large manufacturing centres, consisting mostly of great factories where the capitalist reigns supreme over armies of labourers, usually reduced to the meanest conditions of life, is the ultimate source of all these political evils.

The question is of moment to us here in Canada, for this unsatisfactory state of affairs is beginning to show its evil results even in the New World, where nature's gifts still overflow in prodigal abundance.

It has been truly said that it is very easy to criticize, as it requires neither heart nor head. The author therefore feels the necessity of going a little further; and, assuming that he has correctly diagnosed the disease, he will essay to prescribe a remedy.

It may be presumed that the happiness of the members of the human race, in so far as this depends on merely sub-lunary affairs, is inseparably bound up with the amount of wealth they possess. By wealth it must not for a moment be supposed that money is here meant. This was the error into which the old protectionist statesmen of England fell, when they acted on the supposition that the amassing of bullion was synonymous with the aggregation of wealth. Adam Smith and Ricardo first showed the falsity of this notion and gave the true economic definition of the word, viz: wealth is anything whatever which has an exchange value. So that, when a man possesses anything, whether it be wit or courage or learning or skill, which possesses a value for exchange purposes, he may become a useful member of the community; and in so far as agreeable conditions of life and the commendation of his species can make him so, he may be contented and happy. People whom we are accustomed to call "the poor" have very often large stores of wealth in this sense of the word; and hence mere im-

pecuniosity does not of necessity also imply misery or unhappiness in the case of the fortunate or unfortunate individual involved.

If wealth be one of the most potent factors concerned with happiness, we shall find it necessary, in a search for the causes of discontent amongst the labouring classes and for measures for the removal of the same, first to consider briefly the elements necessary for the production of wealth.

The three great factors which political economists find to be requisite for this purpose are: Land, Capital and Labour.

It will be found, on closer examination, that land and capital are agents of very much the same nature. The latter is defined as that part of wealth which is accumulated to assist future production. Agricultural labourers, for instance, must be supported by wealth previously accumulated; as it is obvious they cannot live on that which they are engaged in producing. It is important to note that capital plays a very subordinate part in the matter, since it is only essential during one single cycle of operations. For if the labourer can exist at all on the fruits of his labour, it is obvious that he only requires assistance during the first production period.

Land, or, to use a broader term, Matter, is evidently an indispensable agent in the production of wealth. In the mere statement that wealth is anything which has an exchange value, it is obvious that the objects included are mostly material and have been derived from land; the exceptions being mostly qualities of mind, which, though not material, yet have a value. The importance of land as an agent of production is so great that at one time political economists in France asserted it to be the sole source of wealth. It has since, however, been shown that labour also is indispensable to the production of wealth.

The exact service which labour renders in the production of wealth is defined by Mill to be "putting things into fit places" or "moving one thing from or to another." This simple definition is so comprehensive as to include all the

varied operations of industry. "Labour in the physical world is always and solely employed in putting objects in motion." Man has no other means of acting upon matter than by moving it.

Money, which is the appointed medium of exchange of valuables, has nowadays also become a commodity, and as such has a changeable value. It ought in reality to be only the means of mobilizing or circulating wealth ; but is now essentially the most highly privileged factor of all, demanding security and interest, and which can itself earn wealth unproductively and without risk. Every operation of credit, if only for the mobilization of actual wealth, begets an excessive demand for the only valid measure of value, viz, Gold. Payments which in their origin had nothing whatever to do with gold must nevertheless be paid in gold. In short, the present monetary system produces an artificial and previously undreamt of demand for this single privileged value-measurer; while it is perfectly conceivable that a medium for the circulation and estimation of valuables could be procured which would dispense with all these questionably essential privileges.

The attempt to ameliorate the condition of the working classes by making a certain amount of wealth a common birthright by an equal division of the land, or rather of the matter of the universe, can never become a *modus vivendi.* It is against laws of nature, such as the struggle for existence and the survival of the fittest, which are not to be got rid of. Endeavours after a common ownership of the land, whether in the gross communistic form or in the blander form of Bellamyism, can never have any result in actual fact.

We must consequently confine our attention to some form of distribution which is consonant with the law of the struggle for existence, and which, as to its possibilities for the individual, depends on his fitness to acquire the wealth which improved conditions of life will enable him to obtain.

Every consideration points to the fact that machinery is

to-day the most powerful wealth-producing agent with which we have to deal.

Machine power is, economically considered, neither more nor less than an enormous massing of labouring power, or vast capability of moving matter, for the production of wealth; in comparison with which the agency of the whole human race is of unimportant magnitude. Labouring humanity is rapidly becoming the intelligent supervisor of the moving force, instead of the moving agent itself. Machine power even now vastly transcends all the human power of the whole earth; it drives the master machine-tools and the highly developed technical machinery which repeats a thousandfold the isolated performances of man. It is also most highly influential on those who live in the most civilized countries.

In regard to this we learn from statistics that, for the work produced by every single labouring man, there is at present more than one hundred times the amount produced by machine power; so that all economic activity is governed by this agency.

This matter has been put in a most striking form by Prof. Riedler of Berlin, by giving to machine power anthropomorphism; say in the form of Chinamen, who are supposed set to work in gangs of one hundred against each one of us to produce commodities. We have only to say, towards the estimation of the result, that our imaginary Chinamen are far more modest and unpretending than real ones; that they require no homes, only workshops to live in; that they feed on coal; never strike; have no personal necessities; and that, when no longer capable of service, they are either repaired or simply broken in pieces.

This mode of viewing the matter makes the enormous influence of this agency more apparent; and no one will venture to doubt, that the sooner we begin to regulate this vast and remorseless power the better it will be,—the more so as statistics show that 80 per cent. of all the mechanical power in the world has arisen within the last quarter of a century.

Neither can this agency be dispensed with and got out of the world; our material culture would then contemporaneously come to an end, for machine power alone has rendered available to the many commodities which were formerly only the privilege of a favoured few. Repression or even limitation of its influence involves, *pari passu*, a reversion to our pre-civilized state.

In these circumstances there remains but one way out of the difficulty.

Instead of confiding to the capitalist the sole mastery and control of this enormous power, upon the right wielding of which the destinies of the race depend, we ought to render it equally serviceable to all, as a beneficent working agent.

The common supply to the whole working community of this all-producing mechanical energy at its proper cheap rate is the solution which the author now proposes for some of the social problems which lie before us in the form of dissatisfaction with present conditions of life in manufacturing centres, and the consequent result of political disaffection and socialism.

That the writer does not overestimate the advantages to be obtained by a general adoption of such a scheme for the encouragement, or indeed creation, of the small or home industries, he will endeavour to show by describing the conditions of life of the factory hand, and then contrasting with them those of an independent workman or small employer.

Consider the case of a workman in a mill or factory. When a young workman he sees no prospect of being able to compete as an independent employer with the large establishments producing the commodities he helps to make; he accordingly never dreams as a rule of saving his earnings for the purpose of establishing himself in business; but, on the contrary, uses the same to minister merely to his pleasures, and frequents the society of men who, like himself, naturally ill content with their conditions of life, indulge in noxious political talking, if nothing worse. When trouble, whether in the form of illness, want of work,

accident or of any other kind, befalls such a man, he at once becomes discontented, begins to complain bitterly, and, instead of viewing his own improvident conduct as the cause of his present state, he throws the blame upon conditions which have very little to do with the matter. If government should interfere on behalf of workmen, to organize a sick benefit or accident fund, in order that the unfortunate artizan may not be forthwith penniless when anything of this kind befalls him; then he murmurs against the deductions made from his wages, at least so long as nothing happens to him which renders an application to the fund for payments possible to him; and when he does have recourse to the accident fund for support, he murmurs equally at the inadequacy of the amount allowed him for maintenance. In this way discontent arises in, grows with and spreads from such a man; the state of things being certainly not improved when, as he advances in life, from which the freshness and gloss have now been removed, he sees nothing before him but his day of toil unrewarded save by his weekly wage. Again, since in great factories large numbers of men work together in relatively small rooms, there is every facility for, as the men are only too prone to be, taking part in the discontent and reiterating the complaints of others. Such places consequently become the very breeding-places for all manner of dissatisfaction with things as they are, and of envy and hatred for more favourably placed fellow-men. That the ideas of revolutionaries have always obtained so wonderfully rapid a hold upon the employés of the large industries can only be explained in this way, and is a proof of the truth of the above contention.

It is far otherwise with a man who can be his own employer. He takes pleasure in and works with diligence and foresight at an occupation from which he anticipates a personal reward for his own industrious skill. He consequently becomes essentially a higher class of man than his compeer in the factory. T e habits of thrift which the successful initiation and pursuit of his little concern have inculcated have a good general effect on his whole moral character.

His intelligence is quickened by the invention of better methods for the carrying on of his work and in the buying of his own materials and the sale of his own finished products.

"Only those can have a real pleasure in their calling" (says Leopold von Kunowski in his *brochure* "Wird die Socialdemokratic siegen"), "who first freely choose it, and afterwards have the hope of seeing before them the fruits of their labour and skill, of attaining for themselves and their families a greater opulence, of reaching a more independent and important position in their profession, and lastly of hereby fulfilling such other good and noble aims as every man carries in his breast to a greater or less extent. These traits of character lie so deeply in man's nature, and are so founded on the natural freedom inculcated equally by his religion and his philosophy, as to be absolutely ineradicable and incapable of being silenced."

To no one can these noble words be applied with greater force and truth than to the small employer, whose industry is not confined within certain specified working hours as with the dependent factory hand, and who by his special skill or business aptitude can attain more and more to a comfortable position. Such an independent workman will be replaced as the generations go on by his apprentices; of whom he ought to have one or two. These should, if they are not already members of his family, live in his house, and they will then from personal esteem take as keen an interest in the business as he does himself. They know that they themselves will some day be small employers, so that no detail of the whole organization will escape their vigilance.

There is no reason why such people as these should not have high moral and political aims, if only a strong government attends to the just protection of their rights and property.

And in such a case the logical conclusion to be drawn is, that in a state where the small industries flourish there will reign peace, contentment, order and prosperity; for dis-

cord imported from without can find no root, and discontentment from within can never arise.

The condition of things in this and other countries is, however, far from being favourable to the small industries.

Large manufacturers can secure not merely the most perfect machinery, but need pay hardly the seventh part of what independent workmen or small employers have to expend for power supply.

The employment of machinery is made as difficult as possible, and sometimes is entirely out of the question, in large towns, by the troublesome regulations, mostly required by the public safety, which are imposed upon prime movers.

The one essential condition for the flourishing of the small industries, however, is their situation in the midst of crowded centres of population; so that the municipal restrictions are especially injurious to the independent workman and small employer; for the large mills and factories may be situated any where in the vicinity beyond the city limit, where a prosperous small industry could not exist.

The result of all this is that all the great technical advances pass over the heads of these workers, since the first requisite for their application is the possession of mechanical energy. They consequently fall hopelessly behind in the industrial race, in which they are so heavily handicapped; and finally cease to exist as a class of any national importance.

The great principle of the division of labour, so closely identified with mills and manufactories, which carries with its adoption the advantages, as enunciated by Adam Smith and Babbage, of (1) increased dexterity of the labourer and his employment on that work at which he is most skilful; (2) time saved by the workman not passing from one employment to another, and (3) suitable machinery more likely to be invented by the concentration of the workman's mind on one process; will be advanced by many as a sufficient reason why large factories must inevitably form the chief part of an economical industrial system.

If this be really the case, then the solution of the problem of the temporal prosperity of the labourer lies in some system of coöperation and the securing of identity of interest by profit-sharing, so that the worker may participate in the results of his industry, skill and intelligence. At the present time the whole benefit accrues to the capitalist who employs him.

Several instances of the successful operation of such schemes are given in Mr. Sedley Taylor's most interesting work on profit-sharing.

With reference to this the writer is not inclined to coincide in the view that labour employ in large factories need form the main or indeed the staple form of industrial production.

Adam Smith's, or rather Babbage's, third advantage of the division of labour, viz: "Suitable machinery more likely to be invented by the workman for the carrying out of the process upon which he is employed," suggests the future result of the production of manufactured articles in this manner.

The effect will always be, and we have seen above that this has already partly taken place during the last twenty or thirty years, that more and more of the labour of the world will be done by machinery, and that the part of man in this work will tend more and more to become that of intelligent supervision. This is indeed the only ground on which higher education for the masses can be justified; for the education of men whose employments demand nothing but mere brute force can result in nothing but dissatisfaction with their condition, or, in other words, political disaffection.

Now the chief reason why this intelligent supervision is at the present time carried on almost wholly in large factories, and therefore with no reward to the labourer in the shape of profit-sharing, is because the capitalist has the entire monopoly of that power or mechanical energy without which the machinery cannot be used.

It happens that the cost of the production of power from coal by means of steam engines and boilers (in comparison

with which all other forms of energy utilization are mere vanishing quantities) gets less and less as the size of the engines gets greater. So much so, that the cost of a horse power to the possessor of a 10-horse engine will be from five to ten times that of the cost of one horse power to the owner of a mill engine of 1000-horse power; while the power of still smaller engines will be proportionately more expensive, costing anywhere from ten to one hundred times as much as it ought and would if supplied by a large engine at a central generating station.

It is thus obvious that such small employers cannot compete on anything like equal terms with mill-owners or large factories; and that, in spite of their usually superior intelligence and their greater zeal and activity, fostered by self-interest, they cannot sell their commodities in the open market as cheaply as can the capitalist with his cheaper power supply.

It is therefore essential for the encouragement and development of the small employer, who earns his own profits, and of the workman doing skilled labour in a workroom in his own house under every human incentive to industry, that efforts should be made to render this mechanical energy, which is so absolutely essential, equally at the service of all. And this must be done so that the power can be supplied to each isolated workman on equal terms and at the same rate as their at present much too favourably treated competitors, the capitalists, obtain it.

If this can be done by any extension of technical possibilities, the writer sees no reason why a great part of the industry at present carried on in factories, with the profits all accruing to the capitalist, should not be transferred to small workshops managed each by its own independent workmen, on competitive equality with other modes of manufacture, and with all the beneficent results on the individual and to the nation at large which such a system has been shown to entail.

That the work would be as quickly, and consequently cheaply, done there is no reason to doubt; and, that it would

be very much better done, is perfectly obvious, when it is simply stated that the interests of the employer and the workman would then be identical.

In the sequel it is proposed to consider the technical possibility of effecting this desirable result, by means of the generation of the power at central stations; under the best conditions of careful management and most economical type and size of prime mover; and its subsequent distribution by means of one or other of the four working agents—steam, air, electricity or water—which have been practically tested and found most capable of good results.

Reclaiming Bog in Westmoreland County, New Brunswick.

By Prof. W. L. Goodwin, D.Sc.

As is well known, the long wedge shape of the Bay of Fundy and its subdivisions causes the tides at the head of the bay to rise to a great height, and to rush up the terminal inlets with much force and velocity. When this rush of water reaches Chignecto Bay it causes a rapid wearing away of the little-resisting clay, sandstone and shale which here form the shores. Thus the waters of the Bay of Fundy are proverbially muddy. The mud is constantly filling up the head waters of the bay, and great stretches of red flats are seen everywhere. Sir Wm. Dawson, in his *Acadian Geology*, has given a careful description of the natural production in this way of fertile "dyke" lands, and has also pointed out that unless such lands are kept drained they deteriorate into "blue dyke," and, finally, I may add, become quaking morasses and even lakes. Thousand of acres of bog, interspersed with fresh water ponds, have thus been formed in Westmoreland County, New Brunswick, and the adjoining Cumberland County, Nova Scotia. These bogs and lakes stretch far into the land, dividing into three series, the middle series reaching from the Bay of Fundy side to within three or four miles of Baie Verte, on the op-

posite side of the Isthmus of Chignecto. The change from solid meadow to bog and lake has no doubt been due to the formation of natural dykes by the deposit of heavier material in greater quantity on to the banks of the creeks, thus enclosing the marsh and preventing the further deposition of mud, excepting by unusually high tides. It is likely that these dykes were increased in height by the action of ice. This was followed by the gradual depression of the enclosed area, in which fresh water collected, forming bogs and lakes. One of the most enterprising and intelligent of the farmers now engaged in reclaiming these bogs has told me that beneath the bog is to be found a great depth of soil exactly like that now being formed by the Bay of Fundy tides. The formation of natural dykes can be observed along the banks of the canals and rivulets which lead the muddy water up into the marshes. The reclamation of bog and conversion of it into meadows of almost inexhaustible fertility has been going on in the parishes of Sackville, Westmoreland and Cumberland for nearly half a century. Canals are cut from the natural tidal channels, so as to lead the salt water into the bogs. The rush of the tides, combined with the flow of fresh water at low tide, gradually wear the canals into wide streams, from which smaller streams can be led in all directions into the bog. The bog settles as the fresh water drains off, and then every tide brings in its quota of mud, which is deposited in layers varying in thickness according to the height of the tide and the distance from the main channel. I have seen some layers of coarser material on the banks of the canals nearly an inch in thickness. Some distance from the canals the thickness varied from one-sixteenth to one-fourth of an inch. The conversion of bog into tillage land occupies several years, varying according to the situation, the depth of water to be replaced by mud, and other circumstances. In the summer of 1892 I saw, bearing an abundant crop of hay, a large tract which in 1867 was a fresh-water lake from ten to fifteen feet in depth. As the filling up process goes on, the level of the soil rises until at length it is covered only

by the highest spring tides. A low dyke, say a foot high, will then keep out the tide altogether, and the work of reclamation is complete. Various plants, the seeds of some coming in with the mud, others being brought by winds and birds, soon cover the red glistening expanse with patches of brown, gray and green. The following is in general the order in which these plants appear. The specimens, gathered by myself, were identified by my colleague, Prof. Fowler.

1. *Spartina stricta*, var. *alternifolia.*
2. *Salicornia herbacea.*
3. *Plantago maritima.*
4. *Suæda linearis.*
5. *Hordeum jubatum* and *Puccinellia distans.*

The salt grass, *Spartina*, grows luxuriantly on the banks of the canals, where it is partially covered by every high tide, and must grow fast to keep its head above the mud.

After a year or two the land becomes suitable for tillage, and then produces large crops of hay and cereals. It is worth from $1.60 to $2.00 an acre, and requires no manure. I have been informed that about 3,000 acres have been reclaimed in the parish of Sackville, and that there is an equal amount awaiting reclamation.

Discovery of Platinum in Place in the Ural Mountains.

By R. Helmhacker.[1]

The metal platinum has up to the present time been obtained only from alluvial washings, and its mode of occurrence when "in place" was for many years a matter of conjecture.

The solution of the problem did not seem difficult. Since the most important platinum deposits occur in connection with serpentine, which is merely an alteration product of

[1] "Zeitschrift für praktische Geologie," February, 1893. Translated from the German by Dr. Frank D. Adams.

olivine or olivine-bearing rocks (as in the case of the largest platinum deposits of the Urals), it might be considered as entirely probable that serpentine or some olivine rock formed the matrix in which the platinum occurred, and from which it found its way into the alluvial deposits.

The very extensive platinum washings in the valleys of the Salda and the Tagil (both tributaries of the Tura, which in its turn is a tributary of the Tobul, which flows into the Irtys) occasionally afforded specimens in which the platinum could be seen intergrown with olivine or chromite. From an examination of the alluvial washings of the eastern slope of the Urals, therefore, it was pretty certain that the platinum had been derived from the disintegration of serpentine rocks, although the metal was never found in place. Very recently, however, these probabilities have become certainties.

About ten years ago, in the Krestovozdvizensky property belonging to Count Suvalov, in the district watered by the rivers Vyzaj and Kaiva tributaries of the Kama, and on the western slope of the Urals, platinum was found in grains disseminated through the rock on which alluvial deposits containing platinum rested. This rock is an olivine gabbro. Another discovery has just been made in the Goroblagodatsk district, on the eastern slope of the Urals, where platinum, associated with chromic iron-ore, has not only been found disseminated in an olivine rock, but has been found in such abundance that the rock can actually be worked with profit. Twenty-two grains of platinum were obtained from one ton of the rock, and although this result was highly encouraging, laboratory assays of other portions of the rock impregnated with platinum have given much higher results, in some cases as much as 93 to 110 grains of platinum to the ton of rock being found.

PROPOSED CHANGE IN RECKONING THE ASTRONOMICAL DAY.

TORONTO, CANADA, 21st April, 1893.

The Canadian Institute in co-operation with the Astronomical and Physical Society of Toronto, have had under consideration the subject of Astronomical Time Reckoning, and have, after much deliberation and consultation, appointed a Joint Committee to suggest the best means of ascertaining the views of astronomers throughout the world.

The Joint Committee have presented the accompanying Report, in which both Societies concur.

On behalf of the two Societies we have the honour to direct attention to the observations and recommendations of the Joint Committee, as well as to the appended extracts, expressing the views of the following gentlemen:—

1. Sir John Herschel.
2. M. Otto Struvè, Imperial Astronomer, Pulkowa.
3. Mr. W. H. M. Christie, Astronomer Royal, Greenwich.
4. Prof. S. Newcomb, Nautical Almanac Office, Washington.
5. Commodore Franklin, United States Naval Obs., Washington.
6. Mr. C. Carpmael, President Astronomical Society, Toronto.
7. Mr. Arthur Harvey, President Canadian Institute, Toronto.

In order to obtain the views of as many astronomers as possible the Joint Committee recommend that answers be invited to the following question:—

Is it desirable, all interests considered, that on and after the first day of January, 1901, *the Astronomical Day should everywhere begin at Mean Midnight?*

It is requested that early answers to this question be sent to the following address:—

JOINT COMMITTEE ASTRONOMICAL TIME,
CANADIAN INSTITUTE,
TORONTO, CANADA.

As it is intended to send copies of further papers on this subject to those replying, it is desirable that the full name, official designation, if any (professional or non-professional) and proper address be furnished with each reply.

ALAN MACDOUGALL,
G. E. LUMSDEN,
Joint Secretaries.

REPORT OF THE JOINT COMMITTEE

OF THE CANADIAN INSTITUTE AND THE ASTRONOMICAL AND PHYSICAL SOCIETY OF TORONTO.

SANDFORD FLEMING, C.E., C.M.G., LL.D., Etc., Chairman.

Canadian Institute.	*Astronomical Society.*
ARTHUR HARVEY, President.	CHARLES CARPMAEL, M.A., F.R.A.S., Etc., Pres.
GEO. KENNEDY, M.A., LL.D.	JOHN A. PATERSON, M.A.
ALAN MACDOUGALL, C.E., Sec.	G. E. LUMSDEN, Corresponding Secretary.

TORONTO, April 20th, 1893.

Your Committee on the subject of Astronomical Time Reckoning, beg leave to report as follows:—

(*a*) That the Sixth Resolution of The Washington International Conference of 1884, which was carried unanimously by the representatives of the twenty-five nations there assembled, counting among them several astronomers of world-wide fame, reads as follows:— "The Conference expresses the hope that, as soon as may be practicable, the Astronomical and Nautical Days will be arranged everywhere to begin at Mean Midnight;"

(*b*) If any action is to be taken on this Resolution, the most appropriate date for the new reckoning to take effect would be the first day of the new century;

(*c*) As the Ephemerides are usually prepared four or five years in advance, it is obvious that if it be decided to make Astronomical Time accord with Civil Time at the date named, a common understanding should not be delayed beyond the year 1895 or 1896;

(*d*) To arrive at an agreement, it is considered essential to ascertain the views of those concerned;

(*e*) The Canadian Institute and the Astronomical Society

should, in the general interest, assume the duty of inviting opinions upon the subject, to be collated, tabulated and published in a special report;

(*f*) If the weight of opinion expressed by those who respond to such invitation, be in favour of a change, further steps may be taken with the view of reaching an international understanding;

(*g*) Your Committee suggest that the opinions which have already been expressed by some leading astronomers be published. To this end, extracts from the writings of Herschel, Struvè, Christie, Newcomb and Franklin, are hereto appended; also, remarks recently made by the President of the Astronomical and Physical Society of Toronto, and the President of the Canadian Institute;

(*h*) Your Committee recommend that replies be asked to the following question, and that it be widely circulated:—

QUESTION.

Is it desirable, all interests considered, that on and after the first day of January, 1901, the Astronomical Day should everywhere begin at Mean Midnight?

(*i*) Your Committee further suggest that astronomers generally throughout the world be invited to send definite replies to the question as soon as convenient. Replies to be addressed, "*Joint Committee, Astronomical Time, Canadian Institute, Toronto, Canada.*"

Respectfully submitted,

SANDFORD FLEMING,

Chairman.

APPENDIX.

EXTRACTS FROM THE OPINIONS OF ASTRONOMERS AND OTHERS REFERRED TO BY THE JOINT COMMITTEE.

I. (935) Astronomical time reckons from noon of the current day; Civil, from the preceding midnight, so that the two dates coincide only during the earlier half of the Astronomical and the later half of the Civil Day. This is an inconvenience which might be remedied by shifting the astronomical epoch to co-incidence with the civil. (147) . . . This usage has its advantages and disadvantages, but the latter seem to preponderate; and it would

be well if, in consequence, it could be broken through and the Civil reckoning substituted. Uniformity in nomenclature and modes of reckoning in all matters relating to time, space, weight, measures, etc., is of such vast and paramount importance in every relation of life as to outweigh every consideration of technical convenience or custom. The only disadvantage to astronomers of using the Civil reckoning is this—that their observations being chiefly carried on during the night, the day of their date will, in this reckoning, always have to be changed at midnight, and the former and latter portions of every night's observations will belong to two differently numbered civil days of the month. There is no denying this to be an inconvenience. Habit, however, would alleviate it; and some inconveniences must be cheerfully submitted to by all who resolve to act on general principles. All other classes of men, whose occupations extend to the night as well as day, submit to it, and find their advantage in so doing. — *Sir John Herschel's Treatise on Astronomy—Third Edition.*

II. Much earnest reflection, on the other hand, must be given to the desire expressed at the meeting, that Astronomical Time Reckoning should be brought in accord with the commencement of the day in civil life. In this matter, astronomers have not simply to abandon a custom of long standing, and consequently to make conditional changes of practice established for many years, but, at the same time, astronomical chronology is disturbed, which is easily understood, must exercise a marked effect on the comprehension of all problems bearing upon matter. Without doubt, the astronomer must make a great sacrifice for the fulfilment of this desire; but, in reality, this sacrifice is not greater than that entailed on our forefathers when they passed from the Julian to the Gregorian Notation of Time, or when they altered the commencement of the year: a sacrifice of convenience by which we yet suffer when it becomes necessary to refer to phenomena of remote dates. At this period, we must the less stand in fear of a like sacrifice, when by such means an acknowledged existing non-accord between science and ordinary life can be set aside: a non-accord which, it is true in individual cases, does not press heavily on the astronomer, but which is a constant source of inconvenience for non-professional astronomers who are desirous of making use of astronomical information. And in such respect, this sacrifice ceases so to be considered and is transformed into an act of public utility with regard to all astronomical details which stand in clear relationship with the outer world in which almost daily conflicts come to the surface between the different designations of dates. Conflicts among others which are even injurious to astronomical

labours in such observatories where observations are continually adjusted to the day. . . . While the Directors of the Pulkowa Observatory make their full acknowledgment to the Astronomer Royal for this precedent, which has been established, so are they ready to follow the example, and this fact leads us the more to expect that also this course will be adopted by the Washington Naval Observatory, as in the American Marine the Date Notation from midnight has been already accepted. It is only in the matter of the period when the Date Notation, according to Universal Time, should be introduced into the publications of the observatories, that we feel inclined to recommend that there should be delay until, in this respect, the most perfect possible understanding be attained by all astronomers, in order to avoid the much more critical disturbance in astronomical chronology which would arise if the transition to the new Date Notation was not equally followed on all sides. We are desirous, accordingly, of suggesting a suitable time-point for the commencement of the year for which the Nautical Almanac would inaugurate the changes corresponding to the requirements named. The latter, as has before been said, could come to pass in the year 1890. We would, however, ourselves prefer the change to take place, in the first instance, with the change of the century. Until that date it would probably be the simultaneous proceeding of all astronomers, with general consent, to look forward to this period of transition, and it would more easily stamp itself on the memory of all who hereafter would be busied in investigation in which exact chronology plays a part.—*Paper on the Washington Conference by Otto Struvè, Director of the Imperial Astronomical Observatory, Pulkowa, Russia.*

III. The reasons for making the change, as affecting astronomers, are:—(1) The introduction of the Universal Day commencing at Greenwich Midnight, and reckoning from 0 to 24 hours makes it inexpedient to have another time reckoning of 0 to 24 hours starting from Greenwich Noon. There are already frequent mistakes of date arising from confusion between civil and astronomical reckoning, several practical observers using the former, which is also commonly employed in almanacs and occasionally in some astronomical periodicals. The use of *three* different systems of reckoning solar time would greatly increase the confusion. (2) The circumstances under which astronomical observations are made have completely changed in modern times since the application of powerful telescopes to meridian instruments and the development of Solar Physics. The change of date at noon in the middle of the day's work has thus, in many cases, become very inconvenient. (3) As regards

meridian observations, the experience of the past year at Greenwich Observatory (where observations are carried on as continuously through the 24 hours as at any other observatory) shows that the whole of the astronomical day can be introduced very easily and with decided advantage on the whole. (4) In the case of extra-meridian observations, the observer usually finds it convenient to work in the earlier hours of the night, so that little or no inconvenience would result from a change of date at midnight. Discoverers of comets and observers of meteors, who observe in the early morning, often use civil reckoning, and mistakes of date have, on several occasions within my own knowledge, resulted from the existence of two different modes of counting time. (5) For spectroscopic and photographic observations of the sun, it is now recognized that the day should be reckoned from midnight, and the same reckoning would naturally be used by the observer when he takes spectroscopic and photographic observations at night, and also in determinations of the places of comets, stars, etc., which he may make in connection with his spectroscopic observations. It seems absurd to expect the same observer to change his system of reckoning mean solar time according to the class of observations he is making at the moment. (6) The proposal to include in the routine work of an observatory, photography of the stars, as well as of the sun, will further increase the difficulty of maintaining a distinction as regards time-reckoning between the various classes of astronomical observations. (7) At many observatories, magnetical and meteorological observations are carried on concurrently with astronomical observations, and it is admitted that for the two former classes the day commencing at midnight should be used. (8) For the distribution of the time to the public, a work which is undertaken by many observatories, the civil day would be used. (9) Thus civil reckoning commencing at midnight must be used for solar, magnetical, and meteorological observations, and also for the distribution of time to the different systems of mean solar clocks, differing by 12 hours, in the same observatory—a circumstance likely to lead to intolerable confusion. (10) As regards the supposed discontinuity which would arise from the change in the Nautical Almanac, the difference of time-reckoning is precisely similar to that which would have to be taken into account in the comparison of Greenwich observations with those made at any other observatory. The astronomical calculator is in the habit under the present system of allowing for the difference in time-reckoning between different observatories, and his task would be greatly simplified if he had only to deal with the universal time.—*Report to the Trustees of Greenwich Observatory, by W. H. M. Christie, M.A., LL.D., Astronomer Royal of England.*

Proceedings of the Natural History Society.

Montreal, January 30th, 1893.

The third monthly meeting was held this evening, T. Wesley Mills, M.D., Vice-President, in the chair.

The minutes of the last meeting were read and approved.

Minutes of meeting of Council of January 23rd were read.

The following donations to the museum were reported, and the thanks of the Society voted to the donors, on motion of Dr. Girdwood, seconded by Mr. Jos. Fortier: A sea dove, from Mrs. Mackenzie; a rattlesnake and a flying fish, in spirits, from Mr. C. T. Hart; a large flag from Mr. James Morgan, jr., and a large rug composed of feathers, from Maorialand, New Zealand.

A lecture on magnetism was then given by Prof. Cox. The lecturer dealt with the recent investigations by Dr. John Hopkinson and others upon the magnetic properties of iron, nickel and cobalt, especially in relation to other properties connected with temperature, electric resistance, thermo-electric action and escalescence, and the bearing of these facts on the magnetic theories of Poisson, Weber, Impere and Ewing.

A vote of thanks was proposed by Dr. Stewart and seconded by the Rev. Dr. Campbell.

Montreal, February 27th, 1893.

The fourth monthly meeting was held this evening, the Rev. Dr. Campbell, Vice-President, in the chair.

The minutes of the last meeting were read and approved.

Minutes of meeting of Council of February 20th were read.

The Librarian reported the usual exchanges received.

On motion of Mr. J. S. Shearer, seconded by Mr. E. T. Chambers, Mr. W. G. Macfarlane was elected by acclamation, the rules being suspended.

Prof. J. T. Donald read a paper on "Some Misconceptions Concerning Asbestos." 1st. It has long been believed that asbestos could resist fire, but it removed the elasticity. 2nd. That the Italian is a different and much superior

mineral to the Canadian, but their composition was identical. 3rd. That asbestos is a good non-conductor; on the other hand, it is a splendid conductor; when made into a fluff containing air, the air will act as a non-conductor. 4th. That it contained chromic iron; the iron always associated with it is magnetic.

On motion of Dr. Wanless, seconded by Mr. W. W. Lynch, the thanks of the Society were given to the lecturer, with the request that an abstract be prepared for publication in the "Record."

MONTREAL, March 27th, 1893.

The fifth monthly meeting was held this evening, Dr. T. Wesley Mills, Vice-President, in the chair.

The minutes of meeting of February 27th were read and approved.

The minutes of Council meeting of March 20th were read.

The Librarian reported two volumes of "Histoire des Découvertes et Voyage dans le Nord," from Mr. E. D. Wintle; a pamphlet on the life of Dr. T. Sterry Hunt, from the author, Prof. Frazer; "Collections of the State Historical Society of Wisconsin," vol. xii, from the Society; and the Annual Report of the Smithsonian Institute for the year ending 1890.

On motion of Mr. E. T. Chambers, seconded by Mr. J. A. U. Beaudry, the thanks of the Society were given to these donors.

After some conversation regarding the proposed saloon adjoining the Society's building, it was moved by Mr. J. S. Shearer, seconded by Mr. Geo. Sumner, that a petition be prepared and signed by the officers and members of this Society, and sent to the License Commissioners, opposing the granting of a license to any saloon adjoining the property of the Society.

The Rev. Dr. Smyth read a paper on "The Attitude of the Church towards Science."

On motion of Prof. F. D. Adams, seconded by Mr. Walter Drake, the thanks of the Society were given to Dr. Smyth for his valuable paper.

MONTREAL, April 24th, 1893.

The sixth monthly meeting was held this evening, Mr. J. H. Joseph, Vice-President, in the chair.

The minutes of meeting of March 27th were read and approved.

Minutes of Council meeting of April 17th were read.

Mr. Shearer reported that the Mayor and Council of St. Agathe would do all in their power to make the stay of the Society in the place comfortable. He recommended that the excursion be to St. Agathe, the matter as to place being left in the hands of the Committee. The date proposed is the 3rd of June.

No additions were reported to the library or museum.

Mr. Chas. Branchaud, proposed by J. A. U. Beaudry, seconded by J. S. Shearer; Mr. Jules Prume, proposed by J. A. U. Beaudry, seconded by Dr. Beaudry; Mr. G. Cyrus Adams, proposed by R. W. McLachlan, seconded by James Gardner, and A. C. MacDonald, proposed by J. S. Shearer, seconded by James Gardner, were proposed as ordinary members. Elected unanimously.

Messrs. C. S. J. Phillips, S. Finley and Dr. Stirling were appointed auditors.

On proposition of Mr J. S. Shearer, seconded by Mr. Sumner, the thanks of the Society were voted to Prof. W. H. Carlyle, Ma.E.; Prof. John Cox, M.A.; Prof. J. T. Nicolson, B.Sc.; Prof. H. T. Bovey, M.A., C.E.; Prof. J. C. Carus-Wilson, and Prof. C. H. McLeod, Ma.E., lecturers in the Somerville course.

A letter was read from Mr. Milton L. Hersey, B.Sc., resigning his membership. Resignation accepted.

Letters from Prof. C. H. Carus-Wilson and the Auer Light Company were referred to the Council.

Dr. R. T. Ruttan then delivered his paper on the "Land Phosphates of Florida."

On motion of Geo. Sumner, seconded by J. S. Shearer, the thanks of the Society were given to Dr. Ruttan for his interesting paper.

Proceedings of the Microscopical Society.

Montreal, 16th January, 1893.

The regular monthly meeting of the Montreal Microscopical Society was held this evening in the library of the Natural History Society, at 8 o'clock. There were present Dr. Girdwood, president, in the chair, and Messrs. J. A. U. Beaudry, J. Stevenson Brown, Learmont, Chambers, McIntosh, Barton, Richards, Hausen, Williams, Drs. Wanless, Stirling, Bruere, McConnell, J. G. Shaw, and also friends of the Society.

The minutes of the last meeting were read and passed.

The President, Dr. Girdwood, then requested Prof. J. G. Adami, M.D., to read his paper on "Methods of Imbedding" The professor described different methods of imbedding subjects. Among them parafine, which could be hardened or made softer as required, and, by the use of a microtome, demonstrated how objects could be sliced off at any angle for the purpose of displaying their structure. The lecture, which was replete with useful information, was listened to with marked attention, and, at its close, the audience evinced their gratification by very hearty applause.

Dr. Girdwood thanked the lecturer, and said he and all present were very much gratified with the clear manner in which the different methods were described and hoped we should have another such treat afforded us.

The meeting then adjourned.

Montreal, 13th February, 1893.

The regular monthly meeting of the Microscopical Society was held this evening, in the Library of the Natural History Society, 32 University Street, at 8 o'clock. There were present, Dr. Girdwood, president, in the chair, and members, Messrs. E. R. Barton, J. S. Brown, Prof. Adams, Chambers, Gardner, Dr. Bruere, Dr. McConnell, Rev. Dr. Campbell, Jas. G. Shaw, and a number of visitors.

The minutes of the last meeting were read and confirmed.

Dr. Girdwood proposed as member Mr. Wm. Angus, 240 Drummond Street, seconded by Mr. J. G. Shaw, which was carried unanimously.

The President then requested Prof. Frank D. Adams, Ph.D., to read his paper on the "Microscope as Applied to the Study of Rocks." The professor began by stating that attempts to investigate the character of rocks and minerals were made in the 17th century but did not amount to much until 1826. Wm. Nicol, the discoverer of the Nicol "Prism," first put in practice the grinding and preparing very thin sections of rock, but not much advance was made till 1850, when Henry Clifton Sirby, an Englishman of very great ability, laid the foundation for the whole science of petrography, and after him Prof. Zirket, of Leipzig, wrote the first general treatise on the composition of rocks. Prof. Adams then described the manner of cleaning a piece of stone, attaching it to a copper or glass plate, rubbing down with coarse, then fine, emery, then with prepared very fine ground rotten stone, then transferring to a slide. Considerable discussion took place on this most graphically described subject which had been listened to with very close attention, and a very hearty vote of thanks was tendered to the lecturer for his most interesting paper. The President drew the attention of the meeting to the great value of this and other papers which were prepared with extreme care by the lecturers, and regretted that many of them not being in manuscript could not be kept among the records of the Society.

MONTREAL, 13th March, 1893.

The regular monthly meeting of the Montreal Microscopical Society was held this evening, in the Library of the Natural History Society, 32 University Street, at 8 o'clock.

The President being unavoidably absent from the city, Mr. J. Stevenson Brown was requested to take the chair.

There were present, Mr. J. S. Brown, chairman, and Messrs. Chambers, Richards, Barton, McIntosh, Learmont, Shearer, Hausen, Sumner, Rev. Dr. Campbell, Williams, J. G. Shaw and Mr. E. A. Small and a number of other visitors.

The minutes of the last meeting were read and approved.

A letter of resignation from Mr. Winn was read, which

elicited many remarks of sincere regret from the members, with the hope that Mr. Winn would reconsider his decision. A letter from Mr. Jas. Fletcher, secretary of the Royal Society of Canada, stating that the annual meeting of that society would be held, in the city of Ottawa, on Tuesday, May 23rd, and requesting the appointment of a delegate from this Society. The President, Dr. Girdwood, was unanimously requested to represent the Society as delegate.

The chairman then requested Dr. A. Arthman Bruere to read his paper on the Microscope in Medico-Legal Investigation. The lecture was most instructive and was illustrated by diagrams, and preparations were placed under microscopes arranged around the table. A lengthy discussion followed, in which many members took part; Dr. Bruere answered many questions put to him in a manner which showed how much interest he took in the subject and how conversant he was with all its details. A hearty vote of thanks was tendered the Doctor.

NOTICES OF BOOKS AND PAPERS.

THE CANADIAN ANTIQUARIAN AND NUMISMATIC JOURNAL, edited by a committee of the Numismatic and Antiquarian Society of Montreal. Published by Monongahela de Beaujeu. Volume III, Nos. 1 and 2, 1893. Montreal, Desaulniers Printing Co., 22 St. Gabriel street.

The Numismatic and Antiquarian Society of Montreal are providing important materials for illustrating the history of the past, and are doing good work, especially for future students of the science of anthropology. Their journal is a most creditable literary production. The last two numbers contain much that is of general interest, besides several articles in which experts in coins and ancient relics are likely to be especially delighted.

Benjamin Sulte's historical articles are exceedingly valuable. Following up his interesting sketch of the Indian settlement in the Bay of "Kenté," embraced in Vol. II, No. 3, he contributes to Vol. III, No. 1, a paper on "Cataracoui," which M. Courcelles chose as

the spot for most effectually checking the inroads of the formidable Iroquois, as well as that most suitable for drawing to itself the Indian trade in peltries, which up till then found its way from the Lake Ontario regions to the Dutch merchants at Albany. No. 2 has a continuation of the subject under the heading of the "First Fort Frontenac," detailing the history of the undertaking and the bearing and address of the great Frenchman whose name it bears, as well as the enterprising La Salle's connection with it. Like all M. Sulte's French writings, these papers are composed in a most charming style. Other articles of general interest are Lemoine's "Hawkins' Picture of Quebec, 1834," "The Building of the Church of Longue Pointe," "The Laying of the Foundation Stone of the Montreal General Hospital, 1821," "Black-Hawk's Speech in 1832 at Prairie du Chien," and a "Sketch of the North-West Company."

EXCHANGES.—Among the most valuable of the recent exchanges of THE RECORD OF SCIENCE is "The Journal of Geology," a semi-quarterly magazine of geology and related sciences, published at Chicago by the University Press of Chicago, of which the second number is before us. All the articles are written with great care, and the get-up of the magazine is all that could be desired, the paper and type being excellent. The first paper in this number is from the pen of C. R. Van Hise, and is one of special interest to Canadian geologists, being "an historical sketch of the Lake Superior region to Cambrian time." This is accompanied by a fine colored plate. "The Geological Time Scale," by H. S. Williams, is a valuable *resumé* of the attempts of geologists to fix the age of the several series of rocks composing the earth's surface. "Traces of Glacial Man in Ohio," by W. H. Holmes, contains an account of the finding of a paleolith in a gravel pit at Newcomerstown in 1890.

"Transactions of the Texas Academy of Science," the first number of which was issued in November last, is one of the latest established organs of the opinions and observations of the active scientists of the United States. It must be said, however, that much of the matter embraced in this initial issue savours more of the spread eagleism of the fourth of July oration than of the modesty and sobriety which characterize true science, which is cosmopolitan. This remark is especially applicable to the last and most interesting article in the journal, "The Development of the American Trotter, a Study in Animal Physics," by Geo. W. Curtis, U. S. A., Director Texas Experimental Station.

R. C.

93.

C. H. McLEOD, *Superintendent.*

DAY.	Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
Sunday.......		....	6.7	0.67	1 ....Sunday
		....	3.5	0.35	2
		....	....	...	3
		....	....	....	4
		....	....	....	5
		....	....	....	6
		....	....	....	7
Sunday.......		....	Inap.	Inap.	8 .... Sunday
		....	2.2	0.25	9
		....	1.4	0.15	10
		....	....	....	11
		....	....	....	12
		....	...	....	13
		....	Inap.	Inap.	14
Sunday.... ..		....	....	....	15 .... Sunday
		....	....	....	16
		....	Inap.	Inap.	17
		....	....	.	18
		....	0.8	0.08	19
		....	0.3	0.04	20
		....	....	..	21
Sunday.......		....	....	....	22 ....Sunday
		....	0.4	0.03	23
		....	0 6	0.02	24
		....	3.2	0.40	25
		....	Inap.	Inap.	26
		....	....	....	27
		....	2.5	0.30	28
Sunday.......		0 16	0.2	0.18	29 ....Sunday
		....	...	....	30
		....	0.6	0.02	31
....M		0.16	22.4	2.49	Sums ....
18 Years mea for and includi this month.....	0	0.82	29.9	3.65	18 Years means for and including this month.

ximum relative humidity was 97 on the 25th.
nimum relative humidity was 53 on the 5th.
in fell on 1 day.
w fell on 15 days.
n or snow fell on 16 days.
roras were observed on 1 night.
ar halos on 3 nights.

Direction.....	
Miles	
Duration in hr	
Mean velocity.	

Greatest mil
Greatest vel
the 29th.
Resultant m

893.

Met C. H. McLEOD, *Superintendent.*

DAY.	Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
		....	0.4	0.05	1
		....	....	....	2
		....	5.9	0.75	3
		....	....	.. .	4
SUNDAY..		....	....	....	5 ....SUNDAY
		0.27	2.8	0.59	6
		....	1.6	0.12	7
		....	....	....	8
		....	Inap.	....	9
		0.08	2.8	0.56	10
		....	....	....	11
SUNDAY..		....	Inap.	....	12 .. ..SUNDAY
		....	....	....	13
		Inap.	....	....	14
		0.07	....	0.07	15
		....	Inap.	....	16
		....	....	....	17
		....	0.8	0.08	18
SUNDAY.......		....	2.7	0.16	19 ....SUNDAY
		....	....	..	20
		....	....	....	21
		....	2.9	0.25	22
		....	....	....	23
		....	....	....	24
		....	....	....	25
SUNDAY.......		....	....	....	26 ....SUNDAY
		....	....	....	27
		....	1.2	0.18	28
	..	....	....	....	29
	..	....	....	....	30
	..	....	....	....	31
....M		0.42	21.1	2.81	Sums ....
18 Years mea for and includi this month....	.8	0.86	23.1	3.07	18 Years means for and including this month.

rometer was 29.296 on the 20th, giving a range 1.570 inches.

Direction..... laximum relative humidity was 96 on the 6th, h and 10.

Miles........ linimum relative humidity was 45 on the 15th.

ain fell on 4 days.

Duration in hr now fell on 12 days.

Mean velocity ain or snow fell on 14 days.

uroras were observed on 3 nights.

Greatest mil loar frost on 1 day.

Greatest vel unar halos on 2 nights.

the 20th. fog on 1 day.

3.

Meteo[d. McLEOD, *Superintendent.*

DAY.	Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	4	....	Inap.	....	1
	1	....	....	....	2
	0	....	....	....	3
	1	....	....	....	4
SUNDAY.. ..	1	....	Inap.	....	5 .... SUNDAY
	3	....	....	....	6
	4	....	....	....	7
	8	....	....	....	8
	4	....	....	....	9
	5	....	....	..	10
	0	0.18	....	0.18	11
SUNDAY . ..	0	0.65	....	0.65	12 .. ..SUNDAY
	0	....	....	....	13
	0	0.23	....	0.23	14
	0	....	2.3	0.24	15
	8	....	0.2	0 02	16
	7	....	0.2	0.02	17
	1	....	....	....	18
SUNDAY ...	3	....	....	..	19 ....SUNDAY
	0	....	....	....	20
	1	....	1.5	0.20	21
	9	....	0.2	0 02	22
	0	....	0 9	0.08	23
	4	0.21	....	0.21	24
	4	0.01	...	0.01	25
SUNDAY.....	1	....	....	....	26 ....SUNDAY
	6	....	....	....	27
	5	....	....	...	28
	0	....	....	....	29
	0	....	....	....	30
	0	....	0 08	0.11	31
....	1	1.28	6 1	1.97	Sums ....
19 Years m[eans] for and inclu[ding] this month .	3	0.94	24 5	3.38	19 Years means for and including this month.

[M]aximum relative humidity was 98 on the 14th, [&] 24th.

Direction... [M]inimum relative humidity was 38 on the 4th.

Miles ...... [R]ain fell on 5 days.

[S]now fell on 9 days.

Duration in [R]ain or snow fell on 14 days.

Mean veloci[ty] [A]n Aurora was observed on 1 night.

[H]oar frost on 6 days.

[L]unar halo on 1 day.

Greatest m[L]unar coronas on the 20th and 22nd.

Greatest v[F]og on 1 day.

the 15th. [S]olar halo on 19th.

Resultant [L]ightning on 23rd.

393.

H. McLEOD, *Superintendent.*

DAY.	ossible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	0	0.40	....	0.40	1
SUNDAY.. ...	6	....	....	0.12	2 ....SUNDAY
	0	....	1.4	0.14	3
	0	0 14	....	....	4
	0	....	....	....	5
	6	....	....	0.20	0
	0	0.13	0.8	0.14	7
	9	0.14	....	..	8
SUNDAY......	7	....	....	....	9 .. ..SUNDAY
	4	....	....	....	10
	3	....	....	..	11
	0	Inap.	....	Inap.	12
	2	0.04	....	0.04	13
	8	....	....	....	14
	0	....	5.4	0.54	15
SUNDAY......	0	....	....	....	16 ....SUNDAY
	6	....	....	.. .	17
	8	0.01	0.8	0.14	18
	5	....	....	....	19
	t	Inap.	....	Inap.	20
	0	0.18	....	0.18	21
	0	....	....	....	22
SUNDAY......	8	0.08	....	0.08	23 ....SUNDAY
	6	....	....	....	24
	7	....	....	....	25
	4	....	....	....	26
	4	0.20	....	0.20	27
	0	Inap.	....	Inap.	28
	8	....	....	....	29
SUNDAY......	4	....	....	....	30 ....SUNDAY
....M	42	1.32	8.4	2 18	Sums ....
19 Years me for and includi this month...	3	1.59	6.7	2.26	19 Years means for and including this month.

nge of 1.376 inches. Maximum relative humid-
y was 97 on the 1st and 3rd. Minimum rela
ve humidity was 24 on the 20th.

Direction....

Rain fell on 12 days.

Miles........

Snow fell on 4 days.

Duration in h

Rain or snow fell on 14 days.

Mean velocit

Auroras were observed on 3 nights.

Greatest mi

Lunar halo on 4 nights.

Greatest ve

Lunar corona on the 26th.

the 8th.

Resultant n

Very heavy thunderstorm on the 7th.

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VOLUME V. **NUMBER 7.**

THE CANADIAN RECORD OF SCIENCE

INCLUDING THE PROCEEDINGS OF
THE NATURAL HISTORY SOCIETY OF MONTREAL,
AND REPLACING

THE CANADIAN NATURALIST.

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[*Incorporated* 1832.]

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THE

CANADIAN RECORD

OF SCIENCE.

VOL. V. JULY, 1893. NO. 7.

ARE THE GREAT LAKES RETAINING THEIR ANCIENT LEVEL?

By Staff Commander J. G. BOULTON, R.N.

(Read before the Association of Dominion Land Surveyors at Ottawa, 16th February, 1892, and now published for the first time.)

This question is not easy to answer definitely, from past experience, because, as far as I am aware, there are no continuous records of the movements of lake waters farther back than thirty years. During this period careful records have been kept, and the question would have been better put in this form: Are the great lakes likely to maintain the mean level of the last thirty years? Or it might be put thus: Have we any reason to fear that the lakes are being slowly but surely drained? I was led to make a few remarks on this subject because of the unprecedently low stage of water at the present time on all the lakes excepting Lake Superior. I have no theory to propound as to the future movement of the lake waters. My object has been simply to collect and give the Association what information I can upon the present and past condition of the inland seas, and invite opinions on the likelihood of their future movements.

Many of the members here present have read of the anxieties of shipowners and vessel captains about the low stage of water last year, and there is little wonder at their alarm when official records kept by the United States Government show that before the close of navigation in 1891 the water in Lake Huron was 3½ feet lower than the level in June, 1886.

What no doubt increases the alarm is that this is not a sudden dip, but a steady fall of half a foot a year since 1886. The members of this Association know sufficient of marine matters to understand how seriously this action of the water may have affected the earnings of the splendid 3000-ton steamers belonging to the States, trading from Lake Erie to Lake Superior, built in 1886, when the water had stood at a high and apparently permanent level for four years. Vessels which when loaded were drawing all the water the canals and artificial channels could give them in the high stage of 1882 to 1886, found on their last trips in the fall of last year 3½ feet less water; that is, if they made the trips at all, which they could only do with half a cargo. To these men, to Canadian shipowners, and to lake commerce generally, the question of the maintenance of the lake level is a very important matter.

From records of the rain and snowfall kindly furnished me by Charles Carpmael, Esq., it appears that the diminished quantity of precipitation since 1886 is nearly equivalent to the amount the water has fallen below the mean level since that date.

In Lake Superior the rainfall has been normal, and the level has not lowered like that of the other lakes. Those well versed in the subject of forestry will be able to say whether the clearing of the woods by fire and axe is likely to cause a permanent diminution of rain and snow.

Evaporation plays an important part in the lowering of the level of the lakes, no doubt, not merely from the sun's rays (which in the course of the survey my officers and myself had reason to feel hot enough at times), but by the dry westerly winds accompanying a bright sky, and blow-

ing with great force and evaporating effect when forming the dry rear semicircle of the revolving storms which pass over the lakes. An alteration in the meteorological conditions to cause for a period a preponderance of these winds in duration and force would, no doubt, have a marked effect on the water of the lakes.

The Welland Canal is an additional outlet for Lake Erie, the Sault Canal for Lake Superior, the lower canals for the River St. Lawrence, and the deepening of St. Clair River for Lake Huron. But I leave it to hydraulic engineers to calculate the additional quantity of water carried off in this artificial way.

Another interesting calculation would be the wearing effect of continual running water at the various rapid outlets. It is possible the rocky outlets of these lakes are wearing deeper by this natural means.

It is not necessary to say much about the reported subterranean passage from Lake Huron to the Gulf of St. Lawrence, because, if it exist, it is probably of very ancient origin, and may be considered a constant factor affecting equally both sides of the equation, the future and the past. Should any member of the Society have made a survey of this passage at any time, a few words from him about it might be interesting. This tradition has some value, however, on account of its being handed down by seamen whose veracity on all matters maritime has *never yet been impugned.*

In 1838 there seems to have been the highest stage of water of which we have any authentic record. This high water has been used by the United States authorities as the plane of reference for the soundings on their charts, and for the records of the oscillations to which I have alluded.

From 1859 to 1887 the mean water-surface of Lake Ontario was 2·1 feet below the high water of 1838. There has been, on the whole, a gradual fall from 1859 to 1872, and a similar rise to 1888. I have not the records from 1888 to date, but have reason to believe the fall has been similar to that in Lakes Huron and Michigan, for which there are records to the end of last year. In Lake Ontario during this period

of twenty-eight years the water has fluctuated from 18 inches above to the same distance below the mean level for that period. The relationship between the rainfall and the stage of water in this lake, however, is not very apparent. The range of the yearly rise and fall is greater in this than in any of the other lakes, having been as much as 4 feet in 1867; the highest water taking place in May and the lowest in mid-winter.

In Lake Erie the mean level from 1859 to 1887 was 2 feet below the high water of 1838. Although the records are not printed to date there is every reason to believe that since 1887 the water in this lake has fallen similarly to that of Lake Huron, of which we have records. There has a been a gradual fall from 1859 to 1872, and a corresponding rise to 1887, but not so marked as in Lake Ontario. The fluctuations on either side of the mean line have not been so great as in Lake Ontario, nor has the yearly range exceeded 1¾ feet, excepting twice.

For Lakes Huron and Michigan the mean level from 1859 to 1887 was 2·8 feet below the high water of 1838. There was a period of low water from 1864 to 1869; again in 1872-73, also in 1879 and 1880. The water then rose steadily to 1886, and has fallen over 3 feet since, or to 1½ feet below the mean level of 1859 to 1889. The average yearly fluctuation is about 15 inches. In those two lakes the periods of high water have been attended by copious rainfalls, and *vice versa*.

For Lake Superior the mean level from 1859 to 1887 is given as 3 feet below the high water of 1838, and this level has been maintained very steadily to the present time. The relationship of the lake level to the rainfall is not very evident here. The yearly fall and rise is about one foot.

In all the lakes, excepting Lake Superior, the period from 1881 to 1886 was attended by high water, its level during the principal summer months having been 1 foot higher than the mean from 1859 to 1887. This period was sufficiently long for men who had not studied the previously recorded movements of the waters to conclude that

this stage of water was the normal condition, and it quite accounts for the alarm of the shipowners and masters, who have had unpleasant reminders by the grounding of their vessels that the water has been steadily falling half a foot yearly since 1886.

The water in Lake Ontario attains its maximum in May, in Lake Erie in June, in Lakes Huron and Michigan in July and August, and in Lake Superior in August and September.

This rapid fall of the water since 1886 was very noticeable in the steep shores of the vicinity of Parry Sound last year, the rocks being void of vegetation and stained black from 2 to 2½ feet above the level of the present water.

Admiral Bayfield in 1820 shows two clean granite rocks just level with the water in that year. In 1887 these two rocks were in the same condition.

Gen. Poe, U. S. A., the best authority probably on the hydrography of the inland seas, says in a letter to me: "I cannot believe that the unprecedently low water in Lake Huron will continue, but think the level will come up again as soon as the precipitation becomes normal. For four or five years in succession the precipitation in the basins of the lakes eastward of Lake Superior has been below the mean, a fact which sufficiently explains the low stage we now have. Still I am further of the opinion that the surface of the lakes has been at some time at a considerably lower level than that of which we have any record, and it is possible that the subsidence may continue till that lower level is reached. That is, evidence exists to show that we are now in the highest state of a series of fluctuations which have long periods, probably a century or two."

Mr. Carpmael, the director of the Meteorological Observatory at Toronto, says: "As to whether the recent deficiency in rainfall is likely to be permanent, is a question of great difficulty. It seems not unlikely, to a limited extent, the recent deficiency may be owing to the diminution of the forests."

GEOLOGICAL NOTES.

By SIR J. WILLIAM DAWSON, LL.D., F.R.S.

The following notes, made in my recent sojourn in the South, may be of interest to some readers of the RECORD:

I.—*The Classification of the Oldest Rocks.*

Much controversy has raged over the age and arrangement of the older rocks of the Scottish Highlands; and ever since I had an opportunity to talk over the subject with my old friend and fellow-student, Prof. Nicol, of Aberdeen, I have felt that the matter was not in a position for a detailed comparison of these rocks with the clearly defined series worked out by Logan in Canada. Quite recently, however, I have read in the new American "Journal of Geology," an article by the distinguished head of the Geological Survey of Great Britain, in which he gives, avowedly for the benefit of those "engaged in the study of the oldest rocks of North America," a summary of the latest conclusions on the subject. From this I deduce the following general statements:

1. The older group of the Highlands is not the whole of the Lewisan group of Murchison, the Laurentian of Logan, but only the lower part of it—the Ottawa group of the Canadian Survey, and this holding probably a larger proportion of intrusive igneous matter than is usual in Canada. He mentions, however, certain rocks of Loch Maree in Ross-shire which, so far as mineral characters go, may represent a portion of the Upper Member of the Laurentian. No doubt when he has time to examine the Western Islands he will find there the Upper or Grenville series as well; so at least specimens from these islands would seem to indicate. I may mention here that recent examinations by Dr. F. D. Adams seem to have confirmed the conclusion that the Upper Laurentian of Logan is mainly composed of igneous material erupted in the latter part of the Lanrentian period, so that in the typical Ottawa region only two bedded members exist, the Ottawa group and the Grenville

series. Whether any of the series of crystalline bedded rocks associated with the typical Lower Laurentian west of Lake Superior and in New Brunswick represent in time these eruptive masses of Anothosite remains as yet uncertain though it seems plain that some of them belong to the seemingly long interval between the Laurentian and the Huronian. For the present, however, the Middle Laurentian or Grenville series may in the Ottawa district be regarded as the Upper Laurentian.

2. The Torridonian sandstones and associated beds in Scotland seem to occupy a position corresponding to that of the Huronian in Canada, and resemble them in mineral character and in the few fossils which they contain.

3. The so-called Dalradian series in Scotland is apparently of uncertain age; but in Ireland it would seem that a similar series holds conglomerates with pebbles of the older gneiss, precisely as the Canadian slate conglomerate does. This also may represent the Huronian or the series approaching to it in age or constituting the upper part which Hunt has named Taconian.

4. The Uriconian and Longmyndian of England and Wales may also, as Geikie suggests, be in part Huronian, or equivalents of the Scottish Dalradian. Specimens of these rocks which I have studied leave the impression that lithologically they may admit of this reference.

5. There remains, however, much probability that equivalents of the remarkable Kewenian series of North America may be included in the latter formations; in which case as in Canada, they may admit of distinct separation as an Upper Huronian or possibly as a downward extension of the Basal Cambrian.

6. It is evident that in Great Britain, as in Canada, the Laurentian rocks had been elevated into land before the Huronian period; and that the latter with the Kewenian constitute littoral formations of coarse clastic material and volcanic ejections following the lines of the old Laurentian coast and constituting the oldest members of those great sedimentary formations which reach upward continuously

through the Palæozoic Period. In Canada they extend in patches along the coast line of the old Laurentian continent and stretch inward into its bays and inlets. The account given of them by Logan and Murray in the Geology of Canada under the names Lower and Upper copper-bearing series is in many respects the best up to the present time, as I can testify from personal examination of portions of the ground.

It may be remarked here that in Canada, though the Laurentian beds are much folded and contorted, they are comparatively little affected by faults or over-thrusts ; and the succession is often extremely clear, while the outcrops of individual beds can be traced over great distances. This applies especially to the Upper or Grenville series, holding the great limestones and beds of graphite and magnetite, and the serpentinous limestone containing Eozoon.

The simple arrangement of the infra Cambrian rocks as Kewenian, Huronian and Laurentian is further vindicated by Walcott's section in the Colorado Canyon, which shows only these superimposed but unconformable. The lowest member is a granitic rock probably equivalent to the Fundamental Gneiss. Walcott has found in the upper part of the infra Cambrian an obscure Discina-like or Stenotheca-like shell and a fragment resembling the cheek of a small Trilobite. Still lower are the stromatoporoid masses of supposed *Cryptozoum*. Some specimens of this recently sliced show distinct traces of structure similar to that of Hall's typical species of Cryptozoum.

In the second number of the "Journal of Geology," Van Hise sums up what is known of the older rocks of Lake Superior and divides them into what he calls "Basement Complex," equivalent to the Lower Laurentian of Logan, Lower Huronian and Kewenian. In this he agrees perfectly with the original classification of Logan and Murray in the Geology of Canada, 1863, except that possibly some Upper Laurentian rocks are included in the "Lower Huronian." The true Upper Laurentian or Grenville series seems, however, to be absent in the Lake Superior

region, so far as yet known. Possibly it may have been removed by denudation before or during the Huronian age, or it may have assumed different mineral characters which may have caused it to be referred to the so-called Kewatin or Lower Huronian group.

2.—*The Most Ancient Fishes.*

Walcott has now found, and showed me when in Washington, large portions of the armour of a Placoganoid from the Siluro-Cambrian of Colorado. These fragments seem completely to remove any doubts as to the nature of the detached plates previously found. They have not as yet been described; but would seem to indicate a type not very remote from some Upper Silurian and Devonian genera.

3.—*Comparison of Existing and Pleistocene Glaciers.*

An interesting and thoughtful paper, by Warren Upham, has just appeared,* in which he institutes a comparison between "Pleistocene and Present Ice-sheets." The present ice-sheets are stated to be four. (1.) The Antarctic or that which fringes the Antarctic continent and is probably better entitled to the name than any other; but which differs from the supposed ce-sheets of the Pleistocene in fronting on the sea and discharging all its produce as floating ice. In this, however, it certainly, resembles many of the great local glaciers of the Pleistocene. (2.) The great nevé of Greenland, which however discharges by local glaciers and these open on the sea. (3.) The Malaspina glacier of Alaska, evidently a local glacier of no great magnitude, though presenting some exceptional features. (4.) The Muir glacier of Alaska, also a local glacier, but perhaps, like the Malaspina, showing some features illustrative of local Pleistocene glaciers.

In the "conferences and comparisons," however, the facts detailed in the earlier part of the paper are placed in comparison with postulates respecting the Pleistocene which are incapable of proof. (1.) It is taken for granted that

* Bulletin Geol. Society of America, March 24, 1893.

the upper limits of glaciation in the mountain ranges of America indicate the thickness of a continental ice-sheet. They probably indicate only the upper limit of the abrasion of local glaciers. (2.) Hence it is computed that the thickness of a continental glacier flowing radially outward in all directions from the Laurentian highlands of Canada, amounted to two miles; and in connection with this it is stated that the maximum thickness of a continental glacier of the great Cordilleran glacier of the west has been estimated to be about 7,000 feet, an entirely different thing and referring to the maximum depth of a local glacier traversing deep valleys. (3.) It is admitted that the assumed continental glacier could not move without an elevation of the Laurentian highlands to the height of several thousand feet, of which we have no evidence, for the cutting of the deep fiords referred to in this connection must have taken place in the time of Pliocene elevation of the continents before the glacial period. (4.) The Upper and Lower Boulder drift, so different in their characters, are accounted for on the supposition that the former comes from material suspended in the ice at some height above its base, the other from that in the bottom of the ice. In like manner the widely distributed interglacial beds holding remains of land plants of North temperate character, are attributed to such small local occurrences of trees on or under moraines as appear in the Alaska glaciers. (5.) The rapid disappearance of the ice is connected with a supposed subsidence of the land under its weight, though from other considerations we know that if this was dependent on such a cause, it must have been going on from the first gathering of the ice, so that the required high land could not have existed. All the evidence, however, points to subsidence and elevation owing to other and purely terrestrial causes, and producing not produced by the glaciers of the Pleistocene.

The paper is short and clearly written, and I think will convince any intelligent reader that the writer could not have arrived at the conclusions he indicates except by assuming the continental glacier as a foregone conclusion.

It may be added that Upham accepts the recency of the glacial period, and its causation by changes of ocean currents, which of course would imply that its date coincided in Europe and America, though not necessarily or probably in the Southern Hemisphere. In the concluding paragraphs he attaches too much importance to the alleged occurrence of implements in the later portion of the glacial detritus. These finds belong in most cases, if not always, to the Post-glacial.

4.—*Erosion by Glaciers.*

Prof. Bonney, F.R.S., in a paper read before the Royal Geographical Society,[1] discusses this question in detail and arrives at the same conclusion which I stated in 1866, after visiting the Savoy Alps; viz., that glaciers are "agents of abrasion rather than erosion," and that in the latter their power is much inferior to that of fluviatile action. Nor are glaciers agents in the excavation of lake basins, which are to be accounted for in other ways; and the great gorges and fiords which have been ascribed to them are due to aqueous erosion when the continents were at a high level, before the glacial age.

5.—*"Palæolithic" Man in America.*

Every reader of the scientific journals of the United States must be aware of the numerous finds of "palæolithic" implements in "glacial" gravels. I have endeavored to show in a work published several years ago,[2] how much doubt attaches to the reports of these discoveries, and how much such of the "palæoliths" as appear to be the work of man resemble the rougher tools and rejectamenta of the modern Indians. But since the publication of that work, so great a number of "finds" have been recorded, that despite their individual improbability, one was almost overwhelmed by the coincidence of so many witnesses. Now, however, the bubble seems to have been effectually pricked

[1] Nature, March 30, 1893.
[2] "Fossil Men," Hodder & Stoughton, London, 1880.

by Mr. W. H. Holmes of the American Geological Survey, who has published his observations in the American Journal of Anthropology and elsewhere.

One of the most widely known examples was that of Trenton on the Delaware, where there was a bed of gravel alleged to be Pleistocene, and which seemed to contain enough of "palæolithic," implements to stock all the museums in the world. The evidence of age was not, however, satisfactory in a geological point of view, and Holmes, with the aid of a deep excavation made for a city sewer, has shown that the supposed implements do not belong to the undisturbed gravel but merely to a talus of loose debris lying against it and to which modern Indians resorted to find material for implements, and left behind them rejected or unfinished pieces. This alleged discovery has therefore no geological or anthropological significance. The same acute and industrious observer has inquired into a number of similar cases in different parts of the United States, and finds all liable to objections on the above grounds, except in a few cases when the alleged implements are probably not artificial. These observations not only dispose, for the present at least, of palæolithic man in America, but they suggest the propriety of a revision of the whole doctrine of "palæolithic" and "neolithic" implements as held in Great Britain and elsewhere. Such distinctions are often founded on forms which may quite as well represent merely local or temporary exigencies, or the debris of old workshops, as any difference of time or culture. All this I reasoned out many years ago on the basis of American analogies, but the Lyellian doctrine of modern causes as explaining ancient facts seems as yet to have little place in the science of Anthropology. It may be added that Wright, in recent papers, attempts to defend some of the "palæolithic" finds against Holmes's criticisms; but his case seems weak.

6.—*Palanthropic and Neanthropic Man in Switzerland.*

Excavations, made by Dr. Nuesch and reported by M. Boule, in the deposits under a rock shelter at Schweizers-

bild, near Schaffhausen,[1] show an overlying deposit with "neolithic" implements and bones of recent animals, a bed of rubble and loam, destitute of human remains, and below this a bed containing bone implements, worked flints, and traces of cookery of the Palanthropic period. The whole rests on a bed of rolled pebbles supposed to be the upper part of the glacial deposits. This shows the interval between the Palanthropic and Neanthropic periods, and also the Post-glacial date of man in Switzerland.

THE DETERMINATION OF LONGITUDE.[2]

By Professor C. H. McLEOD.

If we suppose the earth to be cut by 24 planes passing through the polar axis and being equally spaced, the surface traces will be along lines called meridians, and any point on one of these meridians will be 15 degrees or one hour in longitude distant from any point on the next adjoining meridian. They will be 15 degrees apart because the whole 360 degrees has been divided by 24. Since the earth revolves on its axis once, or through 360 degrees, in 24 hours it will turn through 15 degrees in one hour. So that the longitude distance between the meridians may be spoken of indifferently as 15 degrees or one hour. We shall perhaps avoid difficulty if we speak of longitude differences in hours, or time, only.

If, as a matter of convenience, we make one of our meridians pass through a given point such as Greenwich, then the longitude of a point on another meridian may be described as one, two or three, etc., hours east or west of Greenwich, as the case may be. Thus we say approximetely, Montreal is in longitude five hours west of Greenwich, or more precisely, the longitude of the transit instrument in the Observatory is 4h. 54m. 18s., decimal something

[1] Nouvelles archives des Missions, &c., Vol. III., noticed in "Natural Science," 1893.

[2] Somerville Lecture—delivered April 13th, 1893.

(the precise fraction is at present not quite assured but we have hitherto called it .54) west of Greenwich.

Now imagine one of our meridians—such as that of Greenwich—to be fixed, then the next adjoining meridian to the west will, as the earth revolves, come up to it in one hour, the second in two and so on. Suppose a star or the sun to be on the meridian of Greenwich (i. e., in the plane of the meridian) then the next meridian will contain the star one hour afterwards. That is, in the case of the sun it is apparently 12 o'clock at Greenwich, when, at the westerly station, it is 11 o'clock.

We see, therefore, that if we can determine the local time at any given instant at any two stations and compare these times we have the difference in longitude of the stations. If we know the time at Greenwich now to be one hour and thirty minutes past midnight, when here it is eight hours and thirty minutes past noon, our longitude is the difference in these times, or five hours. The determination of longitude then consists in obtaining the local time at the two stations, and as in all English-speaking countries longitudes are referred to Greenwich, we must, directly or indirectly, know the time at Greenwich. Comparatively few, however, of the longitude determinations made are by direct connection with Greenwich, the usual practice being to determine with the greatest possible accuracy the longitude of a conveniently situated observatory, or station in the given country and from this observatory to establish the various points required by differences of longitude with it.

There are various methods of determining longitude, but none so accurate as what is called the telegraphic method. This method admits of several modifications, but the plan which I shall first describe is now almost exclusively adopted. An observer is required for each station and usually two stations only are concerned. A programme of work having been agreed upon, the stations are occupied simultaneously by the observers. The instrumental outfit at each station should be a transit instrument, a clock and

a chronograph. The stations must of course be connected by a telegraph line. The transit is the astronomical instrument used because by it time can be determined most accurately. This instrument should not be too large to be portable, as there are advantages in an observer constantly using the same instrument and each observer should therefore carry his instrument with him. The chronograph records the beats of the clock, the observations made by the observer at the transit instrument, and also affords the means of accurately comparing the clock at the distant station with his own clock.

The usual programme of work is as follows:—Telegrams are exchanged as to the probability of clear weather at the stations. If the weather be fair the observers will make a determination of their clock errors by the observation of from 10 to 20 stars. This will occupy perhaps two hours, after which an exchange of time signals between the stations takes place. If we call the stations A and B. Then A. sends signals which are recorded on its own chronograph and on the chronograph at B. On land line work it is sufficient to send for one or two minutes, or from 30 to 60 signals and these may be direct clock signals, i. e., the beats of the clock at A sent along the line to B, or may be arbitrary hand signals coming in at irregular intervals on the chronograph record. B then sends an equal number of signals to A, which are also recorded on the chronograph at B. For security against accident it is usual to send a second or check set from A to B and again from B to A. The object of sending signals in both directions is to eliminate what is called "wave time" or "transmission time" If, for example, we are exchanging between Montreal and Toronto, the Montreal clock being ahead of the Toronto clock on local time, the Montreal signals arriving at Toronto will be slightly retarded and the comparison of clocks on the Toronto Chronograph will give a quantity which will be two or three hundredths of a second too small. On the other hand the comparison on the Montreal chronograph will give a quantity two or three hundredths too large, the

Montreal clock having gained that much on the Toronto signals during their transmission. On the assumption that the time of transmission in the two directions is equal, which for land work, at least, we may safely make, the mean of the comparisons gives the precise difference in the clocks. As a matter of fact, clocks at distant stations which are connected by a well insulated land telegraph line can be compared and their difference ascertained with the same accuracy as when beside one another. When in the exchange, clock signals only are sent over the telegraph line, the two systems of signals may be passing simultaneously, the clocks at A and B recording on both chronographs.

The comparison of clocks having been made a second set of star transits is observed. Thus the clock error being known just before and again just after the clock comparison may easily be computed for the instant of the comparison.

The following taken from the Cambridge (U. S.,)—Montreal determination will serve as an example of what has been described :—

Date.	Montreal Clock	Correction	Montreal Time	Cambridge Clock	Correction	Cambridge Time	Difference
	RECORD ON MONTREAL CHRONOGRAPH.						
1883 June 2	h. m. s. 15 36 31.07	s. +2.01	h. m. s. 15 36 33.08	h. m. s. 15 46 34.65	s. —14.33	h. m. s. 15 46 20.32	m. s. 9 47.24
	RECORD ON CAMBRIDGE, CHRONOGRAPH.						
	15 21 27.60	+2.01	15 21 29.61	15 31 31.26	—14.33	15 31 16.93	9 47.32
	Mean difference of time of the stations						9 47.28

Now if the clock corrections here used were quite correct this result, 9m. 47·28s., would be our true and final value of the difference of longitude. Unfortunately, however, it is not an easy matter to obtain a clock error which is true to the nearest hundredth of a second or even to the nearest tenth. It would probably be nearer the truth to say that an uncorrected result of a set of observations by a good observer is likely to be somewhere within a quarter of a second of the true error. If, however, he is a well trained observer he should always be in error (within a range of one tenth of a second) to the same amount and in the same direc-

tion. Thus, a given observer may on the average be 0.25^s. (one quarter of a second) in error, say slow, but he should never be more than three-tenths nor less than two-tenths slow. This is what is called the "personal equation" of the observer. In this case when compared with an absolute standard it is the absolute personal equation. The absolute personal equation is however, a very difficult matter to arrive at, and in longitude operations its attainment is not attempted. What is important is the relative personal equation of the observers and this must, either directly or indirectly, be obtained. If at the commencement of the work or at the end of it, or better both before and after the work, the observers observing the same stars and using their own transits, separately determine the error of the same clock, the personal equation is determined and may be used as a correction to a longitude result obtained when the observers do not occupy both stations. In the example already given, the Montreal observer observed earlier than the Cambridge observer by 0^s.22 and this quantity therefore should be added to the difference of time, giving a value for the difference of longitude of 9^m. 47.28+0^s.22= 9^m. 47^s.50.

Although this method is sometimes employed it is much better to eliminate the effect of personal equation by an interchange of observers. On the completion of the observations with the observers at the stations A and B as already explained, including at least three nights on which full sets of observations have been made at both stations, the observers exchange stations, and make a second series of observations similar in extent and character to the first. Thus, referring again to the Montreal-Cambridge determination three full nights' observations were obtained on June 2nd. 4th. and 5th., the arithmetical mean of the differences of local time uncorrected for personal equation was 9^m. 47^s.292. The observers then exchanged stations, and on June 20th. 21st. and 23rd., the second series was obtained giving a mean of 9^m. 47^s.741. This shows a personal equation of 0^s.224

(equal to half the difference of the results) and gives a mean value for the difference of longitude of $9^m. 47^s.516$. In the final reduction of such work, a process known as "weighting" is employed. That is, some portions of the work are given a greater value than others, depending upon the accuracy and the number of the observations obtained. This does not, however, and should not in good work materially affect the result. Thus, in the work referred to, the mean difference after weighting is $9^m. 47^s.514$ or practically the same as the arithmetical mean.

Another method of conducting a longitude determination telegraphically, is to select certain stars which are to be observed at both stations and recorded on both chronographs. Thus the observer at the easterly station observes a star and records its passage over the wires of his instrument on the chronograph at the western station as well as on his own chronograph. After the lapse of the necessary time (the difference in longitude) the star comes to the meridian of the western station when the observer there, also records it on both chronographs. This method has the practical disadvantage that it requires the use of a telegraph line between the stations during the whole evening instead of during a few minutes as in the method usually employed. It has the advantage, however, of being free from errors due to star places (the time given in the catalogue for the star's passage of the meridian). This small source of error can also be eliminated in the other and usual method if the precaution be taken to observe the same stars at both stations. In the longitude work referred to, five stars were observed on June 23rd., at both Montreal and Cambridge, and recorded on the Montreal chronograph giving a mean difference after correction of $9^m. 47^s.406$; three stars were observed at Montreal and Cambridge which were recorded on the Cambridge chronograph, giving a mean of $9^m. 47^s.523$. The mean value for the difference of longitude from both sets is therefore $9^m. 47^s.465$, a result very slightly less than that obtained by the main determination. This result was given some weight in com-

puting the final longitude difference, Montreal west of Cambridge, $9^m. 47^s.510 \pm {}^s019.$, the $0^s.19$ indicating the probable error of the result, is equivalent to a distance east or west of about 20 feet.

In longitude determinations carried on through land lines the signals obtained are sharp and the transmission time small, so that there is little or no difficulty in comparing the clocks at the distant stations. When, however, an ocean intervenes between the stations, and the signals have to be sent through 3,000 miles of cable the difficulties in the way of the clock comparisons are greatly increased. In fact until quite recently it was not practicable to get any automatic record such as we obtain by our chronographs on land lines. In the longitude determinations between Europe and America, carried out in 1866, '70 and '72 by the U. S. C. & G., Survey, the receipt of the signal through the cable was observed by the deflection of a beam of light from the galvanometer mirrors, at that time exclusively employed in ocean telegraphy. This was a matter of considerable uncertainty and the cause of much anxiety and trouble to the observers engaged in the work.

In our recent longitude work between Montreal and Greenwich the siphon recorder was found, after some little difficulty in its adaptation had been surmounted, to answer all the requirements for an accurate comparison of the clocks at the cable ends. This is believed to be the first occasion on which time signals in longitude work have been received and automatically recorded through an ocean cable. While the wave time was of course large, (amounting on the average to $0^s.26$) the variation from night to night was only a few hundredths of a second.

There is here, however, a possible source of error. The wave time may not be the same for a signal passing eastward as for one passing westward. This we are not able at present to determine, but we have good ground for assuming that the difference cannot in any case amount to any more than a very few hundredths of a second, if it exists at all. The difficulty in the comparison of the clocks is not

the only one peculiar to this work. There is another and more serious difficulty, arising from the large value of the longitude. If the time observations at the two stations are made simultaneously they must be on stars differing in right ascension (the *sidereal* time at which the star passes the meridian)—in the case of Montreal and Greenwich—by five hours. Now as the accuracy of the star places depends upon the going of the standard clock in the Observatory in which the positions were determined, there is a possible systematic error in the relative places of the two groups of stars which would, by just so much, affect the resulting longitude. If on the other hand, the same groups of stars be employed at both stations, i. e., the observations be made at the same time of day, there will be the possibility of error from change of rate of the clocks employed in the longitude work, so that in either case the uniformity of clock rate is concerned. The latter method has the advantage of greater convenience of working hours, and this, as it materially concerns the constancy of the observer's personal equation must have very great weight in the decision as to the method to be adopted.

In the Montreal-Greenwich work there were, in addition to the terminal stations, the two intermediate stations at the ends of the cable—the offices of the Commercial Cable Company at Hazel Hill, Nova Scotia and Waterville Ireland. The observers being designated by the letters A. B. C. D., the programme of work was as follows:—

Date	Montreal	Hazel Hill	Waterville	Greenwich
April, 6 to 12	A & B observations for personal equation..C & D			
April, 19 to 30	A	B	C	D
May, 4 to 20	B	A	D	C

The observer B then went to Greenwich and observed with D and C for personal equation, and afterwards the English observer C came to Montreal.

Aug., 16 to 31	C	A	D	B
Sept., 4 to 17	A	C	B	D

The method of work adopted was that observations at all stations should be made at the same time. The time exchanges were carried out in such a way as to practically give two clocks at each station. Using Greenwich time an exchange was made between Greenwich and Waterville at 8 p.m., and again at 12 midnight. The cable exchange was made at 11.45 p.m. Between Hazel Hill and Montreal, exchanges were made at 11.30 p.m., and 2.30 a.m. The cable exchanges, therefore, came in between the land line exchanges, and near to ne of them. The clocks in the fixed observatories at the terminal stations were available as a check on the rates of the cable station clocks. Unfortunately the reductions of this work are not at the present time sufficiently far advanced to justify any public statement as to results.

In the previous trans-atlantic longitude determinations to which reference has been made, there was no interchange of observers and the telegraphic facilities were comparatively imperfect. Owing to the liberality of the British and Canadian Governments we were in this work able to meet the expense involved in the exchange of observers, and through the generosity of the Commercial Cable Company and the Canadian Pacific Telegraphic Company, an unrivalled telegraphic connection was obtained between the stations. Any reference to our indebtedness in connection with this work is not complete without a record of the great assistance given by Mr. Hosmer and his staff of assistants here, by Mr. Dickenson, the able superintendent of the Cable Company at Hazel Hill, and his chief assistant, Mr. Upham. And beyond the Atlantic, our thanks are due to Mr. Wilmot, the superintendent at Waterville, and to Mr. Bambrige in London, the European representative of the Company.

Of methods other than the telegraphic, the chief one is that depending upon the transportation of chronometers. This is the method almost exclusively employed in navigation. The error of the ship's chronometer with respect to Greenwich time and its rate, being known when the ship

leaves port, Greenwich time may be obtained and a comparison made with the local time as determined by astronomical observation at any point on the voyage. The instrument used in the observations is of course the Sextant. Before the successful laying of the cable in 1866, our longitudes in America depended upon results obtained by this method, the chronometers being carried between Harvard College Observatory and Greenwich. The chronometer errors were of course determined at both observatories by the transit method.

Amongst other methods, the chief are lunar distances and moon culminating stars, in both of which the moon stands for the hands of the clock, the vault of the heavens for the dial and the fixed stars amongst which the moon moves, for the marks on the dial. The nautical almanacs furnish the data by which, from an observation of the position of the moon with reference to certain fixed stars, Greenwich time may be computed at any instant. Owing, however, to the slow movement of the moon, the irregularity of its motion, and the unavoidable errors of observation, these methods have not hitherto furnished results of any great accuracy. The lunar distance method is suited to navigation and chiefly employed in long voyages where the chronometer rates are not sufficiently reliable to establish Greenwich time.

In fact, the honor of having improved the methods of determining longitude at sea is about equally divided between the astronomers and the chronometer makers. This was recognized by the British when a long standing offer of a reward of £10,000 to any one who would find a successful method of determining longitude at sea, was divided between an astronomer who greatly improved the tables of the moon's motion and a watchmaker who improved the marine chronometer.

It was owing chiefly to the difficulty experienced in the determination of longitude at sea and the importance of the problem to navigation and commerce that the Royal Observatory at Greenwich was founded. The duty of the

Astronomer Royal was, on the establishment of the office in 1675, declared to be "to apply himself with the most exact care and diligence to the rectifiying the tables of the motions of the heavens, and the places of the fixed stars, in order to find out the so much desired longitude at sea for the perfecting of the art of navigation."

Notes on a Great Silver Camp.

By W. A. Carlyle, Ma.E., of McGill University.

High up on the Mosquito Range in Colorado, 10.000 feet above sea level, two parties of intrepid prospectors simultaneously discovered, in 1860, in California Gulch in the Arkansas Valley, paying gold-alluvions, and, with characteristic rapidity, a large town, "Oro City," sprang up as in a night close by what was to become the site of Leadville. These alluvial deposits, very rich in gold but limited in area, were soon exhausted in three or four years, when the inhabitants of this "city" vanished as quickly as they had come, for newer and richer diggings, leaving behind a few to carry on a little desultory mining in the gravels and also along some quartz-veins that had been discovered near by, no thought or search being given for any other metal but gold, nor any heed taken of the hoary, iron-stained rock that stuck in the sluices, until in 1875, when some miners, suspecting what others had not, and sending some of this rock to Denver for assay, learned its great value in argentiferous lead carbonates, and by the spring of 1877 active prospecting had begun everywhere in this region, and "from this time on the development of rich and productive mines advanced with astonishing rapidity." (Phillips' "Ore-Deposits.")

These carbonates were soon traced to their source, which proved to be a dark-colored bluish limestone, which thus has ever since been known as the "Blue" limestone, forming the lowest member of the Carboniferous series, that is quite extensively developed through this part of the West. The ore was found to consist of silver-bearing galena, with

gold in some of the chutes, together with the products of alteration, cerussite ($Pb\ Co_3$), horn silver ($Ag\ Cl$), and, as accessory minerals, augusite ($Pb\ So_4$), pyromorphite ($3\,Pb_3\,P_2\,O_8 + Pb\,Cl_2$), minium ($Pb_3\,O_4$), blende $\left((zn\ Fe)\ s\right)$, colamine ($zn\ S\ O_4$), and also native silver. The discovery of this new ore-bearing horizon, so unusual and hitherto entirely unsuspected, began a new era of vast importance to the West and even to the world, as a new territory of large extent was found to the prospector and miner, great ore beds extremely suitable for smelting all classes of ores of the precious metals, owing to the presence of much lead that gathers within itself all the gold and silver in the molten rock of the furnace and then separates from the slag completely, made feasible the present enormous smelting plants; and the production of silver increased with such prodigious strides as to raise the world's supply, thus lowering the ratio value of silver to gold, in as much that the price of silver has depreciated from $1.30 to 83 cents per ounce.

The most ancient rocks at Leadville are Archæan granites and gneisses, the veritable backbone of the Rockies, upon whose flanks lie successively, but little uptilted, Cambrian quartzites or Potsdam, Silurian dolomitic white limestones, Carboniferous limestones (including the "Blue"), grits and shales, and finally rocks and beds of much later epochs. Overlying the Lower Carboniferous limestones, *i. e.*, the "Blue," particularly so at Leadville, or forced in along bedding planes, or cutting obliquely the stratification in dyke-form, is the all-important igneous rock of different varieties of fine-grained quartz diorite or "porphyry," as it is locally called; all-important in that this intrusive rock has undoubtedly played a most important *role* in perhaps being the source of the ore or else a very potent agency in its deposition in these sedimentary formations. Faults occur, some of considerable throw, along which ore is seldom found, except fragmental stuff dragged along the fault planes from the regular ore bodies, although in some work-

ings down below this horizon, or in the quartzites, ore is being now mined along faults where it was first deposited.

As to the vital questions where and how does the mineral occur, in the early days of this district the ore was mined in the "Blue" limestone just below and in contact with the overlying "white porphyry," and these ores for several years comprised mostly carbonates and oxides formed by the decomposition, by circulating surface waters carrying carbonic acid and other solvents, of the original sulphides, which in due course, since greater depths have been reached and mining been carried on below the natural drainage-level, or below the influence of these waters, are found as first formed and are the chief source of supply at the present; for a positively authentic case of the original deposition of lead, silver or zinc as oxides or carbonates, and not as sulphides, is yet to be recorded. Emmons, in the early days of this camp, when but comparatively little work underground had been done, made a careful and successful examination here for the United States Geological Survey, and from the abstracts of his very valuable reports, published in 1882,[1] we glean some of his convictions as to the genesis of these ore bodies. He concludes that the ore was deposited when these formations lay at a depth of 10,000 feet from the surface, and he believes "in the occurrence, on an enormous scale, of intrusive bodies of eruptive rock of Secondary or Mesozoic age, which are so regularly interstratified as to form an integral part of the sedimentary series; and yet which never reach the surface, but were spread out and consolidated before the great dynamic movement or mountain-building period at the close of the Cretaceous.

"The original ore deposition took place after the intrusion of the eruptive rocks, and before the folding and faulting occasioned by the great dynamic movement.

"That the minerals contained in the principal ore deposits

[1] Annual Report of the Secretary of the Interior, vol. iii, 1882, p. 203.

of the region were derived from circulating waters, which in their passage through the various bodies of eruptive rocks took up certain metals in solution; and, concentrating along bedding-planes by a metamorphic or pseudomorphic action of replacement, deposited these metals as sulphides along the contact or upper surface, and to greater or less depths below that surface, of beds generally of limestone or dolomite but sometimes also of silicious rocks."

Leadville is still producing vast quantities of ore, and will continue to do so for many decades, judging by the large bodies now exposed; but much of it, however, is of very low grade in silver, but very valuable as a fluxing ore by reason of the presence not only of lead but a large percentage of iron. It has been proved that throughout the whole thickness of the "Blue" limestone ore bodies may be found, and that, besides running in chutes through the main body, as large and persistent ore bodies are being found at the bottom of this limestone along the "grey porphyry," an intrusion of igneous rock of later date than the "white" first met with above, that not only underlies this limestone but sends tongues up through even into the older porphyry, or intercalates sheets along the stratification planes, significant of the tremendous internal forces that can wedge apart with molten rock the strongly bedded limestones weighted down with thousands of feet of superimposed strata.

Very soon prospectors, now aware of the ore bearing possibilities of the "Blue" limestone, guided in some degree by Hayden's Geological Maps, quickly scattered along the ranges, along whose sides the basalt edges of those deeply formed formations are now exposed, having been forced up by some of the great mountain forming movements that have pushed up granite core masses through the great overlying thickness of sedimentary rock, crumpling, contorting and faulting them, or else re-elevated the veteran primal mountains, around which as islands flowed the Carboniferous seas. For geological evidence there seems to be that these main ranges of Archæan age that form the con-

tinental divide have never been entirely resubmerged, but since their first upheaval on the contracting of the cooling earth crust their summits have ever borne the brunt of attack from the waves and storms of all the succeeding ages. Over many miles in Colorado and Utah these ore-bearing limestones have been traced, and found sometimes lying nearly flat, as at Leadville, or else dipping steeply, almost vertically, as at Mount Snow, Mass., the outcrop presenting in places bold, precipitous escarpments towards the main range. Thousands of mining claims have been and still are being located, but not everywhere does it appear that the mineral depositing conditions have prevailed, although each year develops new areas along this horizon, and established mining districts extend farther along as new mines are discovered, some of wonderful extent and richness.

In 1879 these prospectors crossed over through Independence Pass to the west side of the Sawatch range, the mountains of Archæan rock, and followed the Roaring Fork river in a north-westerly direction down a valley with granite exposures rising high on either side, to where the river cuts across nearly at right angles the steeply inclinal Palæozoic strata, which in the direction of their strike, northeast and southwest, resting upon the granites, rise rapidly on each side of the valley to form Smuggler Mount on the northeast and Aspen Mount on the southwest. On the former mountain there is a thickness of 600 feet of detrital matter or wash, with only the granite and quartzite exposed, with few or no indications of ore-bearing rocks, excepting a mass of sinter-like dolomite at the base that assayed well in silver, and was located as the "Smuggler" claim. But up Aspen Mount runs Spar Gulch, having on the south-east quartzite, and on the northwest a steep lofty wall comprising the upturned edges of the Silurian dolomite and the Lower Carboniferous limestones, the trail in the bottom of the gulch following along the junction of the quartzite and dolomite. Ore was found on this mountain, and at its base now lies the town of Aspen, the prettiest and

most prosperous mining town in the West, whence during the last year ore to the value of $10,000,000 was shipped to the smelters at Leadville, Pueblo or Denver; and for several years the writer was engaged in engineering work that took him into nearly all the great mines, where was learned some insight into the intricacies of the geology and the character of the ore deposits.

A vertical section through Aspen Mount transverse to the strike would reveal:

(1) Archæan granites; (2) Cambrian quartzites; (3) Silurian dolomitic limestone; (4) Lower Carboniferous limestones, *i. e.*, the "Blue" and the "Brown"; (5) Middle Carboniferous shales and shaley limestones; (6) intrusive diorite; (7) Middle Carboniferous limestone (grey); (7) Jura-Triassic sandstones. In this district many differing conditions are noted when compared with Leadville. Here it is seen that a great part of the originally calcareous "Blue" limestone has been altered to dolomite by magnesian waters permeating the stratum, and that the whole of the lower part, together with narrow bands in the upper part or the "Blue," has been thus dolomitized,[1] and is known in the miner's phraseology as the "Brown" limestone, from the brownish color due to the oxidation of iron along faces. These terms "Blue" and "Brown" limestones became both common and important, as the belief was almost general for some years that the Aspen silver horizon was along the bedding plane or "contact" between the limestones, as the ore for a long time certainly seemed on first examination to be thus located, and hence long and expensive lawsuits arose. By the United States mining laws, a claim 1,500 feet, with parallel end lines 50 600 feet long, according to local laws, must be located along the outcrops or apex of a vein or lode, so that the owners may have the right to follow and mine the ore down along the vein as far as possible, even if the vein on its dip passes without the side-lines and

[1] Papers on Aspen in "Engineering and Mining Journal," June, 1888, by D. W. Brunton, M.E., and "Transactions of American Institute of Mining Engineers," vol. xvii, p. 156, by Carl Henrich, M.E.

within the lines of contiguous property, the only boundaries limiting being those formed by the planes passing vertically along these parallel end-lines produced. These rights of the apex were in the main considered proper and just, as up to the time of the discovery of this great ore-zone in those sedimentary rocks veins had been found to have generally a very steep inclination or verticality, and few questioned the justice of the law, although some very curious and complex cases have become famous in the courts. For example, the same vein changing considerably and abruptly in the direction of its strike, two claims are located on this vein, but each along a different direction; then their end-lines produced will overlap, and each will claim that part of the vein thus doubly overlapped; or claims may be located on two veins that intersect or even merge into one another. At Aspen the owners of locations along this outcropping contact between the two limestones have maintained that the ore was placed along the "contact," and constitutes a vein or lode as meant in the law of the apex, and consequently have instituted suits against owners of those locations down from the outcrop in which extremely rich ore-bodies have been found. The camp of miners has been divided into two factions, "Apexers" and "Side-liners," the latter of whom contend that the ore is found in irregular, disconnected bodies, and not as continuous veins or lodes, and therefore, they aver, apex rights cannot here be upheld, and the courts have never as yet exactly decided this point.

Looking at the section taken at Aspen another difference will be noticed in that a great thickness of shales intervenes between the "porphyry" and the "Blue" limestone below. Little or no ore has been found here along the igneous rock, even where in a few places it traverses the limestones as dykes, at which contact the limestone has been marble ized. Ore has been found and mined in these shales, consisting of lead and silver sulphides, but no bodies of high grade and value.

In 1888, Mr. D. W. Brunton, one of the most eminent

mining engine rs in the west, after a very thorough study of Aspen Mt. made while preparing for these apex-side-line law suits, published (loc cit.) a resumé of his views as to the location of the ore and the character of these deposits, in which paper he claimed that the bedding contact between the "brown" and "blue" limestones had *not* been the channel for mineral-bearing solutions, nor the place of deposition of these ores, but that with a strike nearly coincident with that of the strata and a dip of 45° to nearly verticality, was a series of faults, some causing a displacement of a few feet, others of much more, that thus allowed the "brown" and "blue" limestones to be adjacent to each other for hundreds of feet on the dip, but the contact at such places would be along a "fault contact" or place of faulting. That, also, ore-bear ing solutions passing along these fault-planes, did not deposit the minerals from solution *in* these fault planes, but that finding in places conditions physically and chemically favorable, these solutions impregnated to a greater or less distance the rock on one side or the other, or even both, of the fault plane, and some of the mineral contents being precipitated as sulphides, part or all of the rock was locally replaced by ore, by metasomatic or chemical replacement, and that ore *might* be found along a "bedding contact" but only a limited distance from the faults. These views, at first, were derided by all but a few of the mining men, but within two years a mining location was hardly thought valuable unless a fault was known to traverse it, and faults were diligently being sought out and prospected everywhere, as it became evident, beyond doubt, that the "contact" between the two limestones near which such wonderful ore bodies were being found, was a "fault contact." Some of the faults, probably of later fracture have been barren, also faults running obliquely to the first series, although some of these cross faults have had a very important influence upon its ore-bodies.

In the famous "Aspen" mine at Aspen, from whose small area of seven acres, millions of dollars have been

gained, in sinking the shaft an enormous body of very rich silver ore was struck at a depth of 180 feet and in six weeks alone $1,000,000 were won from part of this deposit. Thousands of tons of ore were afterwards mined out of the "blue" limestone, one superintendent thinking that he had exhausted this body, but his successor (changes are often in these mines) making further trials and assays in the apparently valueless solid rock, would find great wealth still remaining until, in places, ore had been sloped out for 30 or 40 feet away from the "contact," on the other side of which the "brown" limestone, nearly perfectly free even of traces of silver, presented a smooth, in parts "slickensided" wall, with parallel, nearly vertical groves or striae, showing so clearly that this was a fault wall. This great body of ore proved to be nearly buticular in shape and rich in lead as well as silver, but on driving levels further along this fault wall for some distance without ore, one of the cross faults was cut along which its strata had been moved 30 feet horizontally, so that the levels now ran through the "brown" limestone, which henceforth proved to be ore-bearing while the "blue" was comparatively worthless. Levels were driven in this as well as in many other mines, along the real bedding contact but almost invariably fruitless.

On Smuggler Mt., in some of the mines, the ore is found in bodies of wonderful richness and extent under somewhat different circumstances. There is one fault coincident in strike, and only a little more vertical in the dip, with the strata, and with such a vertical displacement that the shafts have been brought opposite the "brown" limestone. In this dolomite is a band of very hard chert of irregular thickness and distance from the fault plane, and the ore is found sometimes in its shale, along its contact of shale and dolomite or even sixty feet in the dolomite, but never (unless recently developed) beyond this chert band which in places is separated from the shale only by ore. Another very important fault was met with, dipping only 30° from the horizontal but at right angles to the other fault, and

subsequent in age, along which fault plane the corresponding portions of the strata above and below it were horizontally separated by 210 feet, and of course, the ore bodies similarly situated.

It will be easily understood that in mining in this district the miner constantly meets with many puzzling complications, and a level may be run, all unknown, within a foot or more of ore, but the more extended use of the electric diamond core drill is proving a great ally in easily and cheaply prospecting its formation for 300 or 400 feet in any direction.

The ores of Leadville, as already said, are very favorable for smelting, but at Aspen, most of the ore is "dry" or with less than 5% of lead, and what was for a long time very detrimental, with more or less of "heavy spor" or barite which made the ores refractory. The presence of "copper stain" of the blue or green of copper carbonates in the ore is considered as generally a sure index that it is valuable enough to mine, and sometimes in the mines when a fresh face of ore had been just disclosed on blasting, the ore looked very beautiful with the white glittering spor richly colored with these stains and interspersed with the shining faces of galena crystals in a setting of dull black of silver minerals.

Proceedings of the Natural History Society.

Annual Meeting.

Montreal, May 29th, 1893.

The annual meeting of the Society was held this evening, the Very Rev. Dean Carmichael, President, in the chair.

The minutes of the last annual meeting and of the regular meeting of April 24th were read and approved.

Minutes of Council meeting of 17th April were read.

Hon. Justice Wurtele read the report presented by him on behalf of the Society at the annual meeting of the Royal Society at Ottawa.

A letter was read from Mr. D. McNichol stating that the C.P.R. had completed all arrangements for the excursion to Ste. Agathe on the third of June; Mr. Shearer also reported to the same effect. The President gave a short verbal address, regretting that owing to ill health it had been impossible for him to attend the regular meetings of the Society as he had desired to do. Mr. John S. Shearer then read the report of the Council.

Mr. James Gardner, treasurer, read the Treasurer's Report, showing $2011.17 as the receipts, and $1953.79 expenditure, leaving a balance of $57.47.

Mr. A. F. Winn read the Report of the Curator, in which he stated that many of the specimens in the Museum had been cleaned and re-arranged, and that 1420 persons had visited the Museum during the year.

Mr. E. J. Chambers read the Report of the Library Committee.

The Rev. Dr. Campbell reported on behalf of the Editing and Exchange Committee, showing that the four numbers of the *Record of Science* had been issued during the year.

Moved by Dr. Frank D. Adams, seconded by Dr. J. Wesley Mills, that a committee be appointed to enquire into the condition of the Natural History Society, and make recommendations as to the way in which its condition could be improved, the committee to be selected by the Council of the Society. Carried.

Moved by Judge Wurtele, seconded by J. S. Shearer, that Sir J. William Dawson be elected Honorary President; the rules having been suspended. Carried.

Moved by R. W. McLachlan, seconded by J. S. Brown, that the rules be suspended and Mr. J. S. Shearer be elected 1st Vice-President. Carried.

The following were elected Vice-Presidents by ballot:—Hon. Edward Murphy, Sir Donald A. Smith, J. H. R. Molson, J. Stevenson Brown, B. J. Harrington, Ph.D., F.R.S.C., Rev. R. Campbell, D.D., Geo. Sumner, Very Rev. Dean Carmichael, M.A., D.C.L., J. H. Joseph.

Moved by J. S. Brown, seconded by Hon. Edward Mur-

phy, that R. W. McLachlan be elected Hon. Recording Secretary. Carried.

Moved by J. S. Shearer, seconded by J. S. Brown, that Dr. J. W. Sterling be elected Honorary Corresponding Secretary. Carried.

Moved by the Rev. Dr. Campbell, seconded by J. S. Brown, that A. F. Winn be elected Hon. Curator. Carried.

Moved by J. S. Brown, seconded by Edgar Judge, that James Gardner be elected Treasurer. Carried.

Moved by Geo. Sumner, seconded by S. Finley, that E. T. Chambers be elected Hon. Librarian. Carried.

The following gentlemen were elected members of the council by ballot: Hon. Judge Wurtele, Prof. John Cox, A. Holden, Dr. F. D. Adams, S. Finley, Edgar Judge, C. S. J. Phillips, J. Fortier, L. A. H. Latour.

Moved by J. S. Shearer, seconded by S. Finley, that the following constitute the Editing Committee: Dr. F. D. Adams, Chairman; Rev. Dr. Campbell, Dr. J. Wesley Mills, Dr. Harrington, Prof. John Cox, Rev. Dr. Smyth, J. F. Whiteaves, G. F. Matthews. Carried.

C. G. Arthur, M.A., was proposed as an ordinary member; the rules were suspended and he was elected by acclamation.

On motion by J. S. Brown, seconded by A. Holden, thanks of the Society were given to the retiring officers.

Report of Council.

The Council of the Society beg to submit herewith for the information of the members, and also for the citizens, their report for the Session of 1892-93, to be followed by the reports of the Treasurer, Curator, Librarian, Editing Committee, and their delegate to the meeting of the Royal Society at Ottawa. Eight meetings of Council have been held, and seven monthly meetings of the Society during the year. Seven new members have been added during the session, and three have been removed by death, namely, Dr. G. Ross, Thomas Mussen, and W. F. Ray. The Society's

building is in fairly good condition, but a few repairs will require the attention of the House Committee during next year. The large Hall has again been rented to the same parties who have occupied it for many years past.

Although considerable work has been done this Session by the Society, the same interest has not been evinced as in former years; difficulties had to be overcome, (a very unusual thing) in getting papers for the monthly meetings, and the attendance has not been as large as usual. We hope the officers for the ensuing year will throw themselves thoroughly into the work of the Society, and create by their example, a greater interest in every department. Undoubtedly, the citizens of Montreal do not come forward as they ought, to the support of the "Natural History Society," and contribute liberally to the Museum, the Library, and for lectures during the winter season; we have to depend upon the citizens to furnish the means necessary for this work. The Provincial Government has not given us the annual grant this year. A correspondence has been going on between the Hon. J. S. Hall, and the Chairman of the Council for the past six months, but without any positive result, though there are indications that we may ultimately receive it. This grant, as you are aware, is given to assist in the publication of the RECORD OF SCIENCE. The free course of Somerville lectures, six in number, were delivered to good audiences, during the winter, and were much appreciated. The Museum was open for an hour before each lecture. The lectures were as follows:

Thursday, March 2nd, "THE STORAGE OF ELECTRICAL ENERGY," Prof. Chas. H. Carus-Wilson.

Thursday, March 9th, "THE WEALTH OF MINES," Prof. W. A. Carlyle, Ma.E.

Thursday, March 16th, "LIGHTNING AND LIGHTNING RODS," Prof. John Cox, M.A.

Thursday, March 23rd, "DISTRIBUTION OF POWER BY COMPRESSED AIR AND THE ECONOMIES OF SMALL INDUSTRIES," Prof. J. T. Nicolson, B.Sc.

Thursday, March 30th, and Friday, 31st, "THE COMPARATIVE STRENGTH OF MATERIALS UNDER DIFFERENT CONDITIONS, WITH PRACTICAL ILLUSTRATIONS," Prof. H. T. Bovey, M.A., C.E.

Thursday, April 13th, "DETERMINATION OF LONGITUDE," Prof. C. H. McLeod, M.E.

The thanks of the Society are due to the gentlemen who gave their valuable time in preparing and delivering these lectures. The Society's field day at the River Rouge, on the 4th of June last year, was a success in every respect. A full synopsis of the day's outing will be found in the RECORD OF SCIENCE, Volume V, No. 3. We beg to extend the thanks of the Society to the Hon. J. K. Ward, for his kind invitation and hospitality. Our thanks are also due to the officers of the C.P.R. for their kind, and courteous attention; everything possible was done by them to promote the comfort and enjoyment of the excursionists. The thanks of the Society are hereby tendered to the editing Committee, for the RECORD OF SCIENCE, issued regularly, full of interesting and instructive matter; and we desire especially to thank Dr. Campbell for his work on this Committee. It gives us pleasure to welcome back from the South our Hon.-President, Sir J. W. Dawson, in renewed health, after his long and severe illness, and we hope that he will again, as much as possible, give his valuable assistance to the work of the Society. The health of our esteemed President, the Very Rev. Dean Carmichael, during the past winter, prevented him from being with us as frequently as we could have wished, but we are glad that he is very much better, and able to preside at this meeting to-night.

The membership Committee have not met during the past year; we would urge them for next year, to meet monthly, and endeavour, as far as possible, to prevent members from resigning, and give their attention to getting new members.

The field day of the Society for this year, will be on Saturday, the 3rd of June. The place selected is the village of St. Agathe, formerly called Beresford, on the Canadian

Pacific Railway. We hope the members and their friends will avail themselves of this opportunity of enjoying a pleasant day in a lovely section of the country, amongst the Laurentides.

The whole respectfully submitted.

JOHN S. SHEARER,
Chairman.

REPORT OF THE EDITING COMMITTEE OF THE RECORD OF SCIENCE.

Owing to the absence of Dr. Adams from the country during the early part of the year, and the multiplicity of his engagements since his return by reason of the illness of Sir William Dawson, the duty of overseeing the four issues of the RECORD OF SCIENCE for the past year fell upon me. These numbers averaged fifty-nine pages each, and embraced considerable variety of matter, much of it of a high standard. To the contributors of papers the committee express their thanks, only regretting that the amount of money at their disposal did not enable them to provide such illustrations as were sometimes required to set forth fully the value of the articles. But even with its defects the RECORD OF SCIENCE seems to be appreciated by scientific students in all parts of the world, as is seen by the large and increasing list of exchanges obtained for it.

The question has now to be met whether the RECORD OF SCIENCE is to be continued, in view of the threatened withdrawal of the small grant made to the Society, for the purposes of the publication, by the Provincial Government, for some years past. It would be a serious loss to the science of the Dominion, should it be necessary for lack of funds to cease the publication. Besides it would be injurious to the Society itself in more ways than one. At once most of the additions to the library, and those the most valuable, which come to us as books to be reviewed or as exchanges would be cut off, and the Natural History Society would lose much of the prestige abroad which it has won through this chan-

nel. The committee bring this matter before the Society in the hope that vigorous action will be taken to avert such a calamity as the suspending of the publication would surely prove.

ROBT. CAMPBELL,
Acting Editor

TREASURER'S REPORT.

Natural History Society of Montreal in account with James Gardner, Hon. Treasurer.

RECEIPTS:

To Balance from last year	$ 240 98
Rents	1114 00
Members' annual subscriptions	610 00
Entrance fees, Museum	35 00
Interest	11 19
	$ 2011 17

DISBURSEMENTS:

By Superintendent's salary and commissions	$ 517 20
Sundry expenses	210 21
Light	205 25
Fuel	146 62
Taxes	28 00
Lectures	17 63
Insurance	69 88
Museum	84 67
Library	97 49
Field-day deficit	26 60
Record of Science	300 15
Endowment Fund, 5 life memberships paid in from 1st May, 1885, to date	250 00
Balance on hand	57 47
	$ 2011 17

1893.

May 29, To Balance on hand $57 47

Examined and found correct { SAM'L. FINLEY, CHAS. F. J. PHILLIPS, J. W. STIRLING.

MONTREAL, 29 May, 1893.

The Treasurer stated that the usual Government grant towards the publication of the Record of Science not having been received has necessitated deferring payment of balance of account due the publishers, but it is hoped the grant will be forthcoming shortly, and that there may be no difficulty in this regard in the future, the funds of the Society, as the statement shows, not permitting the continuance of the publication without this assistance.

MEMO.—*Accounts due by the Society:*

Gazette Printing Co., Record account	$ 263 00	
Special Assessment, widening Lagauchetaire Street	17 30	
		$ 280 30

Accounts due to the Society:

Numismatic & Antiquarian Society, balance of rent to 1st May, 1893	$ 30 00	
Plymouth Brethren	2 00	
		32 00

Annual Report of the Hon. Curator, 1892-3.

The following donations have been made to our Museum during the past year:

Ruby throated Humming-bird.
Morning Warbler.
Horn-fly.
Collection of Swiss Butterflies.
Collection of Montreal Plants.
Several specimens of Canadian Insects.
Sea Dove.
Rattle Snake.
Flying Fish.
Maori Feather Rug.

Also a Large Flag for flagstaff of building, presented by Mr. James Morgan.

The mammals have all been taken out of their cases twice during the winter and given a much needed cleaning with benzine, and some will require another going over in the near future. Similar work has been begun on the birds, but only part of the collection has been completely done, as the amount of work is very great and will probably take 3 or 4 months constant labor to put everything in first-class shape. The careful and thorough manner in which this work is being done is very creditable to our valued Superintendent, Mr. Griffin, and the Society is fortunate in having such a willing worker for the position.

The collection of birds' eggs will be arranged by Mr. Wintle, who has kindly undertaken to look after this department, as soon as we can get the cabinet ready.

Botanical specimens have been promised by several members as soon as a case for their reception is provided, and I hope my incoming successor will be instructed by the incoming Council to procure the necessary cabinets at once as we cannot afford to refuse such generous offers as that of Rev. Dr. Campbell, simply because we have no space for them.

The arrangement of the foreign insects has been com-

menced by Mr. Hausen and myself, but there is an enormous amount of work to be done before any of the specimens can be put in place, almost every specimen requiring to be re-set, and most of them are unnamed at present. The collection will however be a great additional attraction to the Museum when arranged, and will no doubt be largely increased shortly.

Respectfully submitted,

ALBERT F. WINN,
Hon. Curator.

REPORT OF LIBRARY COMMITEEE.

The Library Committee have to report the following donations to the library during the past year:—

From M. de Beaujeu, "Le Heros de la Monongahela," "Documents inedits sur la Col. de Longueuil."

From Dr. G. M. Dawson, two papers read by him at the meeting of the Royal Society of Canada.

From Mr. E. D. Wintle, "Histoire des Decouvertes et Voyage dans le Nord." 2 vols.

From Mr. H. Vennor, a copy of Vennor's "Birds of Prey," and from Mrs. Caulfield, "Mudie's Feathered Tribes." 2 vols.

Your Committee have also to report the receipt of 112 different publications from State departments, public institutions and Societies in exchange for the Record of Science.

A complete list of these exchanges is herewith presented, and those requiring it have been duly acknowledged.

A set of all the papers relating to the visit of the British Association in 1884 has been entrusted to the care of the society.

The standard books on science purchased at the end of last session have given general satisfaction to members, and appear to have drawn attention to some other valuable works in the library, the books being much more freely used than in former years.

As the money promised last year for binding the volumes

of exchanges was not provided, there has now accumulated above 180 volumes ready for the binder. These would be a valuable addition to your library. Your Committee trust that you will enable them to get this work done that these volumes may be available for the use of members before the valuable papers contained in them lose their interest.

The absence of those volumes from their proper position on the shelves, prevents the completion of a catalogue which otherwise is nearly finished.

Respectfully presented on behalf of the Library Committee.

E. T. CHAMBERS, *Hon. Librarian.*

EXCHANGES RECEIVED SINCE JUNE 1ST, 1892.

CANADIAN :—

Montreal Medical Journal.
Canadian Institute, Toronto, Transactions.
Canadian Institute, Archæological Report.
Canadian Institute, Appeal on the Rectification of Parliament.
Canadian Institute, Ornithological Section Report.
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ANNUAL FIELD DAY.

On Saturday morning, June 3rd, a large number of members of the Natural History Society with their friends gathered at the Windsor Station ready to leave for Ste. Agathe, the point which had been selected by the Council for the Annual Field Day of the Society.

The weather had been very threatening, rain having fallen in the morning and it was doubtful at first whether the excursion would start. A telegraph from Mr. Carpmael, of the Dominion Meteorological Service, however, stating that the weather would be fine, decided the question and the excursion left about 9 a.m.

The party was much larger than usual, about 180 persons being present. A special train was provided by the C.P.R., and all arrangements were excellent.

On leaving St. Jerome, the newly constructed portion of the road was reached and the Laurentian mountains were entered.

As the engine labored up the steep grades and followed the many windings of the North river, beautiful views were obtained of the mountains rising on all sides.

The district has been hitherto difficult of access and was thus a terra incognita to most of the party.

At Ste. Agathe the whole population were drawn up in their Sunday attire to welcome the Society. The Mayor presented an address from the Town Council, in which he spoke of the honor conferred on Ste. Agathe by its visit, and hoped that nature would yield them many treasures, that the rocks would be found stored with valuable minerals and that the flora would afford them rare and unknown specimens.

Mr. Shearer, Vice-President, called upon ex-Ald. Rolland to reply. After thanking the Mayor and Council of Ste. Agathe on behalf of the Natural History Society for the address, he claimed that this advent would be a great advantage to the place by calling the attention of the outside world to its advantages as a summer resort. The beauty of the lake and the surrounding mountains only needed to become known to attract people seeking relief from the weariness of the town. It remained for the inhabitants to make preparation for their coming by building cottages suitable for them to live in. The harvest would come if they were only ready to gather it in. After a few words by Mr. Sumner announcing that prizes would be offered for the best botanical, geological and entomological collections, the party divided up, some under the leaders of the several sections devoting themselves to the Natural History of the vicinity, while others more attracted by the beauties of the landscape drove or walked to various points in the neighborhood.

Rev. Dr. Campbell and Miss Derick, B.A., were the enthusiastic leaders of the botanical section. Collections were made by a large number of members of the Society, and there was consequently a sharp competition for the prizes in this section. Miss Jessie Brown took that for named specimens, having twenty-one correctly named, and

Miss Smaile obtained the prize for the largest collection of unnamed plants, having fifty-five species.

Mr. H. H. Lyman acted as leader in entomology, and very large collections were obtained by several gentlemen. Mr. Winn secured the first prize for his collection of 104 species, while the second prize was awarded to Mr. Hausen.

Dr. Adams, the leader of the geological section, at the outset explained the general geological structure of the whole district passed over since leaving Montreal, illustrating his remarks by diagrams in coloured chalks sketched on a large slab which was found by the road side. He stated that although the district about Ste. Agathe was most interesting as showing geological structure, the underlying rock was very uniform in character and did not furnish many specimens to the collector. The rock, he stated, was all anorthosite, composed almost exclusively of a lime-soda feldspar, and had been erupted through the true Laurentian rocks forming a great area of 990 square miles in extent. Ste. Agathe was situated about the centre of this area.

The effects of the great pressure to which these rocks had been subjected and which had served to crush them in a peculiar manner, were pointed out, also the effect of the ice, which had ground them down in the last glacial age, as well as the numerous boulders of rocks not found in the vicinity which had been carried to the locality by the ice during this glacial period.

At 5 p.m., there was another gathering of the villagers at the station to say good-bye. The thanks of the Society were expressed in two or three short speeches, and the train started homeward amid the cheers of both the villagers and their visitors. After a fast run home, which was enjoyed as much as the trip out, the Windsor station was reached without further incident. There a vote of thanks, with three hearty cheers, was given to Mr. Mc. Nichol and officers of the C.P.R. for the kindly manner in which the Society had been treated.

Arthur, C. J.
Baker, M. C.
Beattie, John
Bent'ey, D.
Bethune, Strachan
Blackader, Dr. A. D.
Brainerd, T. C.
Brown, J. Stevenson
Bemrose, Jos.
Beaudry, J. A. U.
Baker, J. C.
Bovey, Prof. H. T.
Bond, E. L.
Beaudry, Dr. J. A.
Browne, Dr. A. A.
Botterell, E. H.
Burke, David
Birkett, Dr. H. S.
Baby, Judge
Boulter, G.
Beaujeu, M. de
Branchaud, C.
Campbell, Kenneth
Campbell, Rev. R.
Chambers, E. T.
Cheney, G.
Costigan, W. T.
Craik, Dr. R.
Carsley, S.
Carnegie, J.
Chapman, W. H.
Carmichael, Very Rev. Dean
Cassils, C.
Carter, E. F.
Coristine, J.
Chisholm, C. R.
Cameron, Dr. J. C.
Creak, G.
Cox, Prof. John
Drysdale, W.
Donald, Prof. J. T.
Dyer, W. A.
Deverell, G. J.
Evans, W. N.
Kavanagh, W.
Kinloch, W. G.
Linton, R.
Lockerby, A. L.
Lyman, H. H.
Lovejoy, Dr. G. W.
Lacey, E. D.
Lewis, Mrs. (Assoc.)
Laing Miss "
Lynch, W. H.
Matthewson, J. A.
Mills, J. W.
Mitchell, R.
Morrice, D.
Mills, Prof. T. Wesley
Murphy, Hon. Ed.
Morgan, Jas.
Murphy, John
Martin, Horace T.
Mott, Henry
Morrice, W. J.
Macfarlane, J.
Martin, Mrs. (Assoc.)
Macfarlane, W. J.
Macdonald A. C.
McCallum, Dr.
McDonald, W. C.
McEachran, Dr. D.
McKenzie, H.
McLennan, Hugh
McLachlan, R. W.
McGregor, James
McBean, A. G.
McHenry, G. H.
McLaren, Harry
McDougall, R. W.
Penhallow, Prof. D. P.
Prowse, G. R.
Patton, Thos.
Phillips, C. S. J.
Paton, Hugh
Paton, Jas.
Pennell, A.
Prume, J. J.

Ewing, A. S.
Ewing, S. H.
Euard, W.
Empson, Rev. Canon
Fortier, Jos.
Gardner, James
Garth, C.
Girdwood, Dr. G. P.
Goode, J. B.
Greene, E. K.
Graham, Hugh
Greenshields, E. B.
Grindley, R. R.
Gault, A. F.
Greene, G. A.
Harrington, Dr. B. J.
Henshaw, F. W.
Holden, Albert
Hope, John
Harvie, R.
Henderson, A.
Hill, J. W.
Harper, John
Hodgson, T. E.
Hannaford, E. P.
Hausen, J. F. (Assoc.)
Hague, G.
Huot, L.
Hart, C. T.
Inglis, A.
Ives, H. R.
Johnston, J.
Judge, Edgar
Johnston, Dr. J. W.
Jackson, F. S. (Assoc.)
Ross, P. S.
Roddick, Dr. T.
Ruttan, Dr. R. F.
Robertson, Alex.
Stirling, John
Shearer, James
Shorey, H.
Shearer, John S.
Silverman S.
Smith, Sir D. A.
Smyth, Rev. W. J.
Stevenson, R. R.
Slessor, J.
Smith, J. Murray
Smith, Annie Louise (Assoc.)
Stirling, Dr. J. W.
Small, E. A.
Stewart, Dr. J.
Scott, W. A.
Shepherd, Dr. F. J.
Shaw, J. Gibb
Thomas, F. W.
Thomas, H. W.
Van Horne, W. C.
Vasey, T. E.
Williamson, J.
White, R.
Williamson, Rev. J.
Wanless, Dr. J.
Winn, A. F.
Wurtele, Judge
Wilson, Prof. C. Carus
Ward, Hon. J. K.
Wintle, E. D.

PROCEEDINGS OF THE MICROSCOPICAL SOCIETY.

MONTREAL, 10th April, 1893.

The regular monthly meeting of the Montreal Microscopical Society was held this evening in the library of the Natural History Society, 32 University Street, at 8 o'clock.

Present, Dr. Girdwood, President, in the chair, Senator Murphy, Dr. Sterling, and Messrs. Stevenson, Geo. Sumner, Richards, Learmont, Chambers, Beaudry, Johnston, Gardner, Lovejoy, Shaw. The minutes of last meeting were read and confirmed.

At the request of the President, Dr. Wyatt Johnston then read an exceedingly interesting paper, his subject being the "Microscope in Medicine." He began by saying that it was about 30 years since the microscope began to be used in the investigation of different diseases to which humanity was subject, and by its aid an immense amount of light had been thrown upon what was now termed the germ theory. In such diseases as tuberculosis, heart disease, la grippe and others, the bacilli in the sputum could be recognized by the aid of the microscope, and the practitioner was greatly assisted in diagnosing his case. Through the same instrumentality it had been proved that dysentery was caused by an intestinal parasite, and the discovery of the common bacillus of cholera was also due to its power. In the examination of blood it was shown to be invaluable; it not only revealed its condition, but often assisted the physician to locate disease when other methods failed.

Great interest was manifested in the experiments which followed, as Dr. Johnston gave practical illustrations of the methods employed in the examination of blood.

At the close of the lecture the members present joined in a general discussion of the subject, and before adjourning a very hearty vote of thanks was tendered to Dr. Johnston for his interesting lecture.

The President then announced that the last lecture of the season would be delivered by J. B. McConnell, Esq., M.D., C.M., subject, "Normal Histology of the Brain and Spinal Cord."

The meeting then adjourned.

SWEDISH CAMBRIAN-SIBERIAN HYOLITHIDÆ AND CONULARIIDÆ.[1]

This memoir marks an era in the study of these conical shells of the older Palœozoic rocks. The author, Dr. Gerard Holm has had unusual facilities for the examination of these fossils, having had before him the large collections of the Swedish Geological Survey, amounting to over 1100 examples, and 45 operculæ, as well as numerous specimens from the museums of Stockholm, Upsala, Christiania, Copenhagen, &c.

Dr. Holm discusses the zoological position of Hyolithes at considerable length, of which the following is a summary:

This type of shell was at first taken to be a Pteropod, and has been so described in all the earlier, and best known works on Palæontology, but of late years serious objections have been made to this view.

Among the objectors are Neumayr and Pelseneer; the former of these writers (1879-89) considers that the Hyolithidæ belong to an entirely independent extinct group of animals, which never had a place near the Pteropods, but were nearly related to the Gasteropods; he thinks there can be scarcely any doubt that they are molluscs.

Neumayr undoubtedly makes a mistake when he, following the old custom, unites the genera Hyolithus and Conularia in the one family or division. Between these genera there are surely great differences—as the following:

In *Hyolithes* the shell is solid, rigid, thick, and consists of at least three layers; it is composed of calcium-carbonate. In *Conularia* it is thin, flexible, and formed of calcium-phosphate, united with a horny substance.

In *Hyolithes* the shell is bilaterally symmetrical with dorsal and ventral sides plainly marked. In *Conularia* it is quadrately or rhombically prismatic, without any distinct dorsal and ventral side, etc.

The mouth of the shell in *Hyolithes* is not drawn together, but is always furnished with an operculum. In *Conularia*, on the contrary, the mouth has its four sides bent inward, and never has an operculum.

Hyolithes appeared earlier than *Conularia*, and there is no indication that the latter spring from any form of the former, or from any common ancestor.

Lindström has examined the zoological standing of Conulariidæ and concludes that they ought to be referred permanently to the

[1] Sveriges Kambrisk—Siluriska Hyolithidæ och Conulariidæ, Series C., No. 112 af Gerhard Holm, Stockholm, 1893.

Pteropoda until some better ground can be shown for removing them to another group in the animal kingdom—better than have been shown by Hackel, Neumayr and Jhering.

Pelseneer has lately fully and profoundly discussed the Palæozoic groups which have been referred to Pteropoda, as to their relationship to living Pteropods, and showed that nearly all the chief characters of Hyolithes and Conularia are entirely wanting in the Pteropods now existing. Pelseneer refers the Pteropods to Ophistobranchia among the Gasteropods, considering that they have sprung from the Bullidæ and Actæonidæ. The remains of Pteropod are wanting in nearly the whole of Mesozoic time, which is hard to understand if they had already appeared in numerous forms in the Palæozoic. Pelseneer shows with reason that it appears to be a fixed law of nature that a group of animals once extinct can never reappear.[1]

The result of Pelseneer's investigations agree fully with Neumayr's statement that Hyolithes and Conularia cannot belong to any living group, and thus can stand in no generic relation to the Pteropoda. In opposition to Neumayr he shows that they probably belong to widely distinct groups, but does not attempt to define their place in the scale of being.[2]

Likewise Walcott has been uncertain of the place of Hyolithes and Conularia, &c., though he places them under the category of Pteropoda as being in a measure representative of recent Pteropoda, they differ in other respects so much that it appears as though a division of the Gasteropoda equivalent to the Pteropoda might consistently be made to receive them.[3]

The fossil which Linnarsson described as *Hyolithes lævigatus* is by G. Holm removed from that genus, and the new genus Torellella instituted for it. The shell as in Conularia consists of *calcium phosphate*, the form is round, firm, weakly arched, of nearly equal breadth; a compressed tube with elliptical section, of which the edge of the orifice must have been straight. He refers this shell as well as Salterella and Tentaculites to the Annelida.

Of the Family Hyolithidæ, Holm says that it contains only the genus Hyolithus, and that other genera have certainly been referred here erroneously. Some show themselves to be less well

[1] Pelseneer, P., Report on Pteropoda collected by H. M. S. Challenger during 873-76—Zoology Vol. 23, London, 1888.

[2] The connection with modern Pteropoda may be through Styliola and Creseis, &c., which collectively range through the Lower and Upper Silurian and Devonian. Some of these minute forms may yet be detected in the Mesozoic rocks. G.F.M.

[3] Second contribution to the study of the Cambrian faunas of North America, Bullet. No. 30, U.S. Geol. Surv., p. 131. See also Trans. Roy. Sco. Can., Vol. iii, pt. iv, p. 47, 1885.

grounded and belong under Hyolithus, (*Camerotheca*, *Diplotheca*, Matt. *Pharetrella* Hall); others probably have no relation to Hyolithus (*Coleoprion*, Sandb. *Coleolus*, Hall and *Clathrocælia* Hall); still others are grounded on objects whose structure has been misapprehended (as *Hemiceras*,[1] Eichw, and *Hyolithellus* Bill.)[2]

HYOLITHIDÆ

Holmes describes the genus *Hyolithus*[3] very fully, as follows:

Shell bilaterally, symmetrical, pyramidal, or conical, more or less elongated, straight or slightly bent in a symmetrical plane, rarely towards one of the sides. Cross section usually sub-triangular, but also circular, elliptical or lenticular. Dorsal and ventral sides usually distinguishable.[4] Dorsal side slightly arched, flat or gutter-shaped. Ventral side strongly arched, generally more or less angulated along the middle. Mouth angulated or straight; in the first case with dorsal side semicircularly arched; in the latter, on the other hand, cut off straight or oblique against the dorsal or ventral side. The sculpture consists of growth lines parallel to the orifice, occasionally besides of longitudinal elevated lines or mouldings, whereby more or less complicated sculptured surfaces can arise. Diaphragms are often observed in the apex of the shell; they are entire, not perforated by any siphon. The operculum completely closed the mouth, no matter whether the same was angulated or straight; sometimes it was slightly conical, with the nucleus nearest the ventral side, and with concentric growth lines.

[1] "*Hemiceras* is evidently grounded on the interior of siphons of Endoceras, as plainly appears from Eichwald's figures of all three species."

[2] Speaking of the family *Hyolithellidæ* of Walcott, Holm says "The name is quite inapplicable * * * since the genus *Hyolithellus* Bill. is grounded chiefly on a Brachi pod previously described by Hall under the generic name *Discinella* which Billings and Walcott wrongly declared to be the operculum of a form nearly related to *Hyolithus*. This was, by the last named authors, placed together with some shining tubular form, whose nature is hard to determine."

[3] He adopts this spelling as the correct form of the name, though the originator of it, Eichwald, wrote Hyolithes.

[4] "Opinions have changed as to which side should be regarded as the dorsal, and which the ventral. In the simplest forms both sides are quite obscurely differentiated, but with the more highly developed genus (subgenus *Hyolithus* sens. strict), the separation on the other hand is plain. With the latter two opposite sides can always be distinguished, they are shown by a more or less sharp edge. One of these sides is longer and has the edge of the orifice strongly arched forwards, and this is considered the dorsal side; the other whose mouth-edge is transverse, as the ventral. Same conception has been entertained by Salter, Matthew, and from 1886 by Walcott. But Hall, Billings and Walcott, before 1886, have held the contrary view Barrande avoided distinctly determining this point by applying the terms "La grande face," (dorsal side) and "Les petitis faces (ventral side). Novak named them "Die Hinderflache," and "Die Vorderflache. By following the development from the higher stages backward to the lower, one can decide even in the earliest form which side is dorsal and which ventral in the sub-genus Hyolithus sens. str."

Shell formed of calcium-carbonate, of the same nature and appearance as in Gasteropods.

Dr. Holm says that species of Hyolithus have been described under the following generic names:—*Hyolithes*, Eich. *Orthoceras*, Munst., *Theca*, J. Sow, *Pugiunculus*, Barr., *Vaginella* (pars.) d'Orb· *Cleodora* (pars.) Ludw. *Cleidotheca* (pars.) *Centrotheca* (pars) Salt. *Cryptocaris* (pars) Barr. *Camerotheca* (pars.) *Diplotheca* (pars.) Matt. *Orthotheca* (pars.) Novak, *Pharetrella* (pars.) Hall, *Ceratotheca* (pars.) *Bactrotheca* (pars) Novak.

Although Dr. Holm rejects *Orthotheca* Novak as a genus he accepts the term as of sub-generic value, and divides Hyolithes into two subgenera as follows:

Subgenus 1, ORTHOTHECA, Novak, 1887.

Mouth quite transverse, forming one plane, Operculum thereby also flat or slight convex, seldom with the nucleus concave, but always having the edge of the operculum in one and the same plain. The dorsal part of the operculum is never distinctly semiconical.

Subgenus HYOLITHUS, sensu. str., Eichwald, 1840.

Edge of the orifice on the dorsal side semi-circular projecting, on the ventral side the edge is transverse, therefore the mouth of the shell forms two planes coming together at an obtuse angle. Operculum having the same form as the mouth, and similarly angled, and consisting of a small lunate ventral part and a semi-conical dorsal part.

Dr. Holm has been at great pains to arrange systematically the forty species of Hyolithes which have passed under his observation, and as he has in almost all cases been able to show the exact geological horizon from which these species have come, the arrangement is of great value to the biologist. In his sub-genus *Orthotheca* we find the following sections:

1. *Teretes.* The transverse section circular or almost circular—Cambrian (Kjerulfi to Forchammeri Zone).

2. *Complanati.* The transverse section perfectly rounded, but with the dorsal side distinctly, though slightly flattened. Lower Cambrian.

3. *Plicati.* The transverse section, reniform, cordiform or triangular, with the dorsal edge of the section concave, the dorsal side strongly grooved. Cambrian (Œlandicus-Forchammeri Zone).

4. *Semielliptici.* The transverse section semi-elliptical or subtrapezoidal. The lateral edges sharp or almost sharp. The dorsal side plain or very slightly grooved. The aperture usually obliquely cut, with the ventral side projecting (—Bactrotheca, p. p., Nov.) Lower Silurian.

5. *Quadrangulares.* The transverse section almost rectangular.

The shell with four quite sharp edges, and four sides flat or slightly concave The aperture obliquely cut, with the ventral side longer. On the surface of the shell fine longitudinal raised lines prevailing. (—Bactrotheca, p.p., Novak). L. Silurian.

6. *Lenticulares*. The transverse section almost symmetrically lentiform. The lateral edges extraordinarily acute. The lines of growth on the dorsal as well as on the ventral side concave. Upper Silurian.

In the sub-genus *Hyolithus*, as restricted by Holm, he finds two main divisions, these are:

I. *Æquidorsati*. The ventral side wanting grooved channels near the lateral edges. If the lines of growth there change direction that is done by degrees with an even curve. The boundary line between the real dorsal and the ventral sides are therefore the same as the lateral edges of the shell, which are almost always sharp.

II. *Magnidorsati*. A little from each of the lateral edges on the ventral side is a stronger or feebler channel, bordered outward by one or several longitudinal raised lines at the side of the channel, the growth suddenly changes in direction, Those channels are the boundary lines between the real dorsal and the ventral sides, which therefore are not identical with the lateral edges of the shell, the dorsal side turning along those edges, and passing into the ventral half of the shell. What seems to be the ventral side, therefore, is divided into three fields, those belonging to the turned over dorsal side, and that in the middle being the real ventral side.

Under the division *Æquidorsati* the following groups are contained.

1. *Transversistriati*. The surface of the dorsal side as well as the ventral side has lines of growth only——This is a large section containing species ranging from the Œlandicus Zone to the Upper Silurian (*c*.) of the Swedish divisions.

2. *Ventrilineati*. The surface of the dorsal side with lines of growth only, that of the ventral side, ornamented with coarser or finer lines, straight longitudinal raised lines covering the whole breadth of surface. The lateral edges acute.—Forchammeri—Lituite Zone, mostly Lower Silurian.

3. *Dorsilineati*. The dorsal side with longitudinal raised lines over the whole surface, or at least at the lateral edges.—Lower Cambrian to Trinucleus Zone.

4. *Crispati*. The surface of the shell on the dorsal side as well as on the ventral side with very elevated lamelliform longitudinal raised lines, most often with the edge more or less undulating.—Lower Silurian.

Under the division of Magnidorsati are the following divisions:

1. *Aequali.* The ventral side rounded without a sharp keel in the middle.—Vaginatus to Lituite limestone.

2. *Carinati.* The ventral side sharply keeled, with the lip and lines of growth of the middle field, forming either a single strongly projecting obtuse angle, or two side arches, separated by an inward curvature The channel bordered outward by a single strongly developed longitudinal raised line.—Olenus Zone to Vaginatus limestone.

These are the main divisions of Dr. Holm's classification, but each is sub-divided into one or more sections and sub-sections, and the Swedish type species of each section mentioned, so that the scheme forms a complete key to the classification of the Swedish species, and a most valuable reference for the Hyolithoid form of all countries.

This classification, based as it is on so large an amount of material, will be of great service in the future study of this group of fossils. As it is largely based on external ornamentation it is more readily available than if it turned entirely on internal structure. It has accomplished for Hyolithes what de Verneuil's classical work did for Orthis nearly fifty years ago,[1] but in a much more complete and systematic way. By treating the genus in its relations to time and space it brings out the genetic relations of the different sections of Hyolithes, and shows the simpler forms to have been the earlier.

The tendency of opinion in modern times, however, is to the breaking up of large and unwieldy groups such as Hyolithes and Orthis, and so we think that future writers will, by using lines of descent, endeavour to perform this service for Hyolithes, as it has been done recently for Orthis by Messrs. Hall and Clarke. Whatever may be attempted in this way in future years it is certain that Holm's classification of Hyolithus will be found exceedingly useful.

There are other features in this work well worthy of study. Following the example of Barrande in his work on the Pteropoda of Bohemia.[2] Dr. Holm devotes considerable space to the geographical distribution and vertical range of the different species of Hyolithes. Systematic and complete tables are given of the occurrence of species in Sweden, Norway, Denmark, Russia, Great Britain, Bohemia, Canada, United States and other countries. Also a

[1] Russia and the Ural Mtns, 1845.

[2] Système Silurien de la Bohême, Vol. III.

[3] Genera of Palæozoic Brachiopoda, Part I, 1892.

list of all described Cambrian and Silurian (Upper and Lower) species, with synonyms. The total number of species of Hyolithus, including those of the Devonian, Cambrian and Permian, are stated by Holm at 178. He gives a list of species-names suppressed as being synonyms or wrongly applied; also an historical outline of the literature of the genus in Sweden, also an "Attempt at a Natural Grouping."

This scheme or table for a natural grouping, intended to show the derivation and supposed genetic relations of the several sections of Hyolithes will interest biologists. Dr. Holm finds that the only species outside of Scandinavia which can be used for a purpose of this kind are those of Bohemia and North America, others are few in number, or imperfectly described or based on defective material. The oldest forms known at the base of the Cambrian show already two "stem forms," viz., the two sub-genera of Hyolithes, which Dr. Holm recognises represented by several species; hence he infers that the Lower Cambrian Hyolithes of necessity must have sprung from some older, and to us unknown fauna.

About sixty-three pages of the work are devoted to descriptions of the numerous Swedish species, most of which are herein for the first time described.

CONULARIIDÆ.

The Conularias form a less important feature of this work than the Hyolithidæ, the species of the former genus being somewhat scarce in Sweden, and the work not treating of any later species than those of Silurian age. But the description of the group has been carried out with the same completeness and assiduous attention to detail which marks the part relating to the Hyolithidæ. Bohemia still stands forth as "par excellence" the region of the Conularias, with twenty-four species, unearthed and described chiefly by the illustrious Barrande. Sweden presents sixteen species described chiefly by Holm and Lindström, while the United States has eighteen species, nearly half of which have been described by Jas. Hall. The only species known, older than the Lower Silurian, is one described by Walcott from the Upper Cambrian.

As with Hyolithes so in this genus Dr. Holm gives a tentative natural grouping of the species. He divides them as follows:

1. *Læves.* Shell smooth, only having growth lines, which appear as wrinkles. Segmental line indented.

2. *Longitudinales.* A preponderating sculpture of longitudinal elevated lines. Segmental line elevated.

3. *Moniliferæ.* Sculpture obliterated by cross threads beset with

tubercles, without any fine threads connecting the former, or of tubercles only, arranged in transverse rows.

4. *Cancellatæ.* Sculpture a lattice work of transverse coarse main ribs, always plainly and sharply bent at obtuse angles; also finer and lower small ribs connecting the former.

The forms are further classified under these general heads by more minute variations of sculpture, as in the case of the Hyolithidæ, so that the whole scheme forms an excellent key to the identification of species.

About sixteen pages of the work are devoted to the description of the Swedish species of Silurian (Upper and Lower) Conulariidæ.

TORELLELLIDÆ.

Gen. *Torellella* Holm.

Under this heading is described two small slender organisms which Dr. Holm separates from Hyolithes, chiefly because the shell is composed of calcium phosphate (66 per cent.) He regards them as probably allied to the worms. One is from the Lower Cambrian the other from the Lower Silurian, and as regards the former he expresses surprise that no related species has been found in the Lower Cambrian of North America. It has been collected from the Lower Cambrian of Norway, Sweden, Finland and Denmark. He suggests that *Hyolithes elongatus* Barr. and *Coleoprion bohemicum* Barr. and *C. Sandbergeri* Barr. may belong to this genus.

Dr. Holm's work is illustrated by six excellent plates showing in detail the characters of all the species treated of in his memoir, which is one of the series of works published by the Geological Survey of Sweden, and one of the most meritorious, in that it introduces order into the chaos of species heretofore passing under the name Hyolithes, Theca, &c.

G. F. MATTHEW.

[M]AY, 1893.

187 feet. C. H. McLEOD, *Superintendent.*

[Sk]y Clouded [i]n Tenths. Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.	
.0	10	10	00	0.15	....	0.15	1	
.0	10	10	00	0.47	....	0.47	2	
.0	10	10	00	0.03	....	0 03	3	
.0	10	10	00	0 94	....	0 94	4	
.0	10	10	00	0.23	....	0.23	5	
.8	10	3	04	0.09	....	0.09	6	
..	....	.	76	....	....	..	7	.... SUNDAY
3	10	0	80	....	....	....	8	
5	10	2	67	....	....	....	9	
5	10	0	96	....	....	...	10	
0	00	0	91	....	....	....	11	
2	10	0	86	....	....	....	12	
8	10	0	24	0.01	....	0.01	13	
.	....	..	04	0.05	....	0.05	14	...... SUNDAY
0	10	0	19	0.16	....	0.16	15	
0	10	10	00	0.05	....	0.05	16	
0	10	10	00	0.18	....	0.18	17	
0	10	10	00	0.23	....	0.23	18	
8	10	0	22	0.04	....	0.04	19	
0	10	0	95	0.01	....	0.01	20	
.	....	..	00	....	...	....	21	.. ..SUNDAY
5	10	0	97	....	....	...	22	
7	10	0	00	0.14	....	0.14	23	
0	10	5	72	....	....	....	24	
2	10	0	58	0 31	....	0 31	25	
2	10	0	72	.	....	....	26	
7	10	0	45	0 07	...	0 07	27	
.	....	....	53	0.11	....	0 11	28	... .SUNDAY
7	6	0	97	....	....	....	29	
3	10	0	46	0.09	....	0 09	30	
5	9	0	87	....	....	....	31	
8	..	..	¶41 6	3.36	....	3.36	Sums	
8	..	..	50 2	2.89	....	2.89	19 Years means for and including this month.	

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...giving a
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High-

est barometer reading was 30.261 on the 8th ; lowest barometer was 29.245 on the 17th, giving a range of 1.016 inches. Maximum relative humidity was 97 on the 2nd and 16th. Minimum relative humidity was 23 on the 12th.

Rain fell on 19 days.

Auroras were observed on 2 nights.

Solar halo on the 9th

Thunderstorm on 4 days.

NE, 1893.

37 feet. C. H. McLEOD, *Superintendent.*

Clouded Tenths. Max.	Clouded Tenths. Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
10	0	49	....	....	....	1
10	10	07	0.06	....	0.06	2
10	5	14	0.68	....	0.68	3
...	..	07	1.35	....	1.35	4
						5 .. ..SUNDAY
7	0	93	....	....	....	
10	7	00	0.46	....	0.46	6
10	0	71	....	....	..	7
8	0	93	....	....	....	8
8	0	84	....	....	....	9
10	4	83	....	....	..	10
....	..	00	0.43	....	0.43	11 ....SUNDAY
10	0	14	0.07	....	0.07	12
10	0	77	....	....	....	13
2	0	88	....	....	....	14
5	0	91	....	....	....	15
10	0	17	Inap	....	Inap	16
10	6	35	0.32	....	0.32	17
10	0	85	0.08	....	0.08	18 ....SUNDAY
10	0	69	0.06	....	0.06	19
7	0	85	....	....	....	20
9	0	88	....	....	....	21
10	6	00	0.07	....	0.07	22
10	4	00	0.52	....	0.52	23
10	0	15	0.49	....	0.49	24
....	..	56	....	....	....	25 ....SUNDAY
10	1	00	0.40	....	0.40	26
10	8	32	....	....	....	27
6	0	89	....	....	....	28
8	0	72	....	....	....	29
6	0	96	....	....	....	30
						31
..	..	50	4.99	....	4.99	Sums ....
..	..	¶54 1	3.44	....	3.44	19 Years means for and including this month.

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Warmest
High-

est barometer reading was 30.187 on the 1st; lowest barometer was 29.612 on the 22nd, giving a range of 0.575 inches. Maximum relative humidity was 99 on the 23, 24 and 27th. Minimum relative humidity was 40 on the 15th.

Rain fell on 14 days.

Auroras were observed on 2 nights.

Fog on 2 days.

Thunderstorms on 6 days.

Published quarterly; Price $3.00 the Volume of eight numbers.

VOLUME V. NUMBER 8.

THE CANADIAN RECORD OF SCIENCE

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AND REPLACING

THE CANADIAN NATURALIST.

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[*Incorporated* 1832.]

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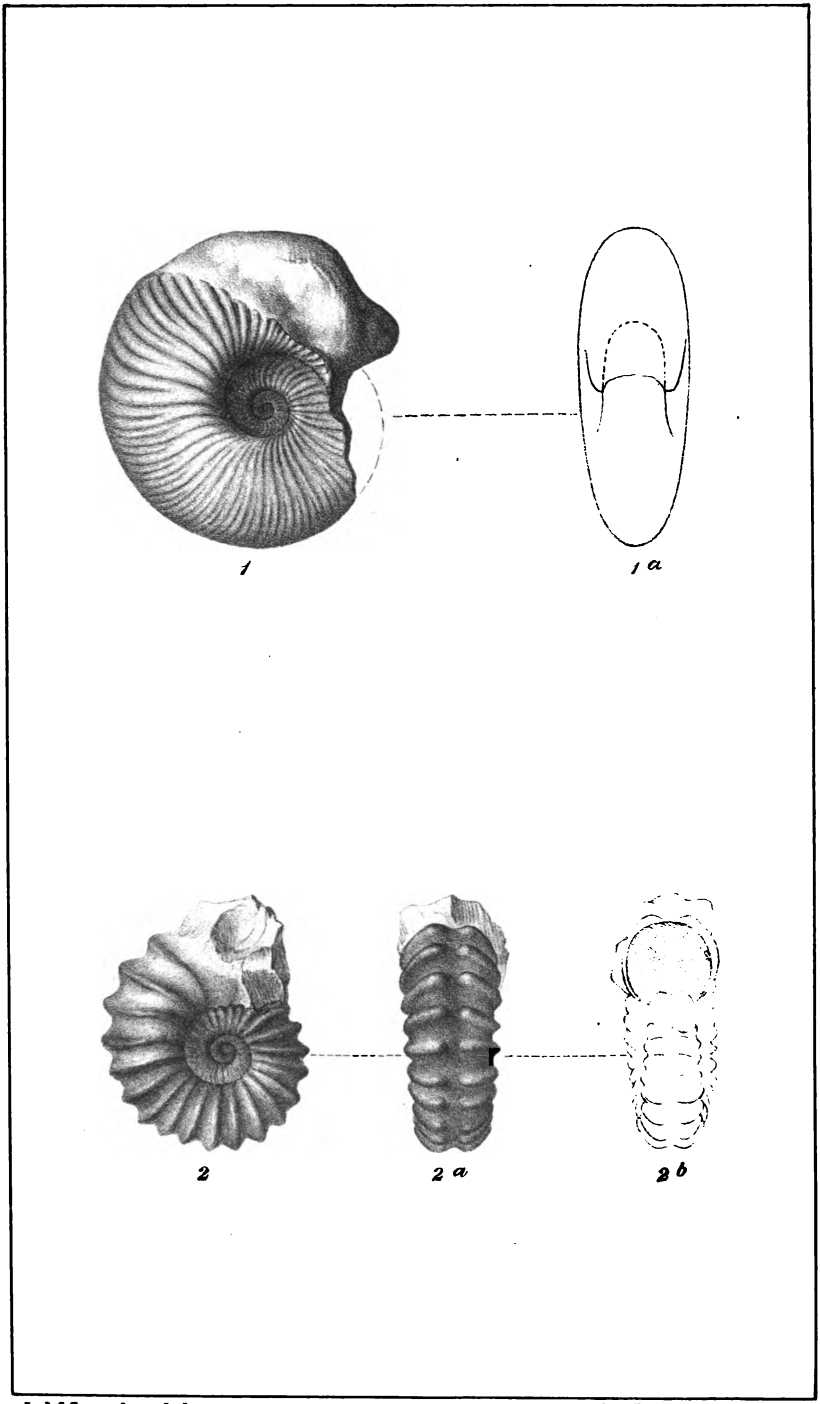

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AMMONITES FROM Q.C. ISLANDS.

THE

CANADIAN RECORD

OF SCIENCE.

VOL. V. OCTOBER, 1893. NO. 8.

DESCRIPTIONS OF TWO NEW SPECIES OF AMMONITES FROM THE CRETACEOUS ROCKS OF THE QUEEN CHARLOTTE ISLANDS.*

By J. F. WHITEAVES.

Through the courtesy of Dr. C. F. Newcombe, of Victoria, V. I., and by kind permission of the council and members of the Natural History Society of British Columbia, the whole of their collection of the fossils of the Cretaceous rocks of that province has recently been sent to the writer for examination and study. Among these fossils there are two small Ammonites which appear to be undescribed, both of which are labelled as having been collected at Skidegate Inlet, Q. C. I., and presented to the society by Mr. James Deans. Both are clearly referable to the family of Stephanoceratidæ of Neumayr, as amended or re-defined by Zittel. One is an imperfect specimen of a small species of *Olcostephanus*, nearly related to *O. Jeannotti* (the *Ammonites Jeanuotti* of d'Orbigny [1]) of the Neocomian of France and Switzerland. The other is a more perfect but apparently not quite full-grown specimen of a species of *Hoplites*, of the type of *H. sinuosus* (the *Ammonites sinuosus* of d'Orbigny [2])

[1] Paléont. Franc., Terr. Cret., vol. i, p. 188, pl. 56, figs. 3-5.

[2] Ib., p. 204, pl. 60, figs. 1-3.

*Communicated by permission of the Director of the Geological Survey Department.

of the French Neocomian. The exact characters of the sutural line are unfortunately not well shown in either of these specimens. The two species represented may be provisionally described as follows, with the proviso that the diagnoses of each are, of course, subject to such modifications or amplifications as may be made necessary by the discovery of more perfect specimens.

OLCOSTEPHANUS (ASTIERIA) DEANSII. (Sp. nov.)
Plate VII, figs. 1 and 1 *a*.

Shell small, compressed at the sides and narrowly rounded at the periphery: umbilicus occupying rather less than one-third of the entire diameter. Volutions three or four, increasing rapidly in size, especially in the dorso-lateral direction, and rather closely embracing, about two-thirds of the sides of the inner ones being covered, the outer one a little higher than broad: aperture elliptical in outline but deeply emarginate by the encroachment of the preceding volution.

Surface marked by numerous, closely arranged, small but distinct, though not very prominent, flexuous, transverse ribs, which bifurcate about the middle of the sides and then pass uninterruptedly over the periphery.

The sutural lines are so crowded together and confused that, although fairly well preserved in places, it is scarcely possible to follow the details of any single one. The siphonal saddle, however, is small, a little higher than broad, with a minutely trifurcate apex, and an appressed spur on each side below. The first lateral saddle is large, ramose and unequally bipartite or obscurely tripartite at its summit. The siphonal lobe is large and symmetrical, with three branchlets on each side, two of which are lateral and one terminal, but the lowest of the two pairs of lateral branchlets is much the smallest of the three pairs.

The only specimen collected is considerably eroded near the aperture, as represented in fig. 1, but in the uneroded portion the maximum diameter is about forty millimetres, and the greatest breadth fourteen.

The writer has much pleasure in associating with this species the name of its discoverer, Mr. James Deans of Victoria, V. I., who accompanied Mr. James Richardson in his exploration of the Queen Charlotte Islands, in 1872, and who has since presented some unusually perfect specimens of the fossils of the Cretaceous rocks of those islands to the museum of the Geological Survey Department at Ottawa.

O *Deansii* appears to belong to the small group of Ammonites of which *Olcostephanus Astieri* is the type, and for which M. Pavlow has recently (1891) proposed the generic or subgeneric name *Astieria*[1] According to M. Pavlow, the Olcostephani of the group of *O. Astieri* form a natural group, a genus (*Astieria*) if one prefers to consider the Olcostephani as a family, or a subgenus if one would rather regard *Olcostephanus* as a genus.

The shape and surface ornamentation of *O. Deansii* are very similar to those of *O. Jeannotti*. But in *O. Jeannotti* the ribs bifurcate at the umbilical margin, and are represented as so prominent as to everywhere break the general contour if the shell is viewed laterally. The siphonal saddles of *O. Jeannotti*, too, are described as broad, and the figures show that they are much broader than high. In *O. Deansii*, on the other hand, the ribs bifurcate half way way across the sides, at a considerable distance from the umbilical margin, and are not sufficiently prominent to interrupt the continuity of the outline of the shell in a full side view. The siphonal saddles of *O. Deansii*, also, are narrow, and, as already stated, a little higher than broad.

The genus *Olcostephanus*, which was founded by Neumayr in 1875, is abundantly represented in the Upper Jurassic and Lower and Middle Cretaceous rocks of Europe. The only other species that has been definitely recorded from the Canadian Cretaceous is *O. Loganianus* (nobis), from Skidegate Inlet, whose characters are still very imperfectly known. As stated elsewhere,[2] however, it is most probable that the so-called *Haploceras Cumshewaense* (nobis), from

[1] Bull. Soc. Imp. Naturalistes de Moscou, Année 1891, N. Ser., vol. v, p. 491.
[2] Trans. Royal Soc. Canada, vol. x, sect. iv, p. 114.

Cumshewa Inlet, belongs to that section of the genus *Olcostephanus* for which M. Pavlow has since proposed the subgenus *Virgatites.*[1]

Hoplites Haidaquensis. (Sp. nov.)

Plate VII, figs. 2, 2 *a* & 2 *b*.

Shell small, strongly costate and widely umbilicated, the umbilicus, as measured from suture to suture, occupying about one-third of the entire diameter. Volutions about three, though the nucleus is not preserved in the only specimen collected, increasing rather rapidly in size and slightly embracing: the outer one moderately convex, a little broader than high, the outline of a transverse section being subpentagonal if made through one of the ribs, or not far from circular if in the centre of one of the grooves between them: aperture nearly circular but shallowly emarginate by the encroachment of the preceding volution.

Surface marked by large and prominent, simple and nearly straight, transverse ribs, which are separated by rather broad concave grooves. The ribs, which are equal in length, are most elevated on the outer or peripheral portion of the last volution, and in the median line of the periphery there is a single angular notch on each rib which scarcely interrupts the continuity of the rib.

Sutural line not clearly defined, but apparently not very complicated nor much branched. The first and second lateral saddles appear to be much broader than high, and doubly incised rather than ramose at the summits. The first lateral lobe seems to be trifurcate above and unusually small, though apparently much larger than any of the others except the siphonal lobe.

Maximum diameter of the only specimen collected, twenty nine millimetres: greatest breadth of the same, twelve mm.

The specific name suggested for this little Ammonite is a modification of the word Hai-da-kwe-a, which Dr. G. M.

[1] Op. cit., p. 471

Dawson quotes as the Indian name for the Queen Charlotte Islands, in his report on these islands, published in the Report of Progress of the Geological Survey of Canada for 1878-79.[1] The shell itself appears to belong to the subgroup Dentati-regulares of the Dentati. of Pictet's classification of the Ammonites in the "Paléontologie Suisse,"[2] and to that section of the genus *Hoplites* which Zittel calls the group of *Ammonites interruptus*.[3] In many of its characters it is very similar to *Hoplites sinuosus*, but it seems to have fewer and more distant ribs than that species and a different sutural line. Thus the type and only known specimen of *H. Haidaquensis* has twenty-two ribs on the outer volution, while that of *H. sinuosis*, which is almost exactly the same size, is said to have thirty-four. The sutural line of *H. Haidaquensis* seems to be more like that of *H. crassicostatus*, as figured by d'Orbigny,[4] in which the first and second lateral saddles are represented as broader than high, whereas the corresponding saddles of *H. sinuosus* are represented as higher than broad.

The genus *Hoplites* also was proposed by Neumayr in 1875, and is regarded as eminently characteristic of the Cretaceous epoch. *H. Haidaquensis* and *H. Canadensis* (nobis),[5] from the Clearwater shales and Peace River sandstones of the district of Athabasca, are typical and characteristic Canadian species of this genus. *H. McConnelli*[6] (nobis), from the Clearwater shales of the Athabasca, appears to be rather an aberrant member of that section of the genus which Zittel calls the "group of *Ammonites cryptoceras*." It is also most probable that the fossil from Comox, Vancouver Island, which Meek doubtfully referred to his genus *Placenticeras*, under the name *P. Vancouverense*,[7] is also referable to *Hoplites*.

[1] P. 104 B.
[2] Prem. partie, p. 328.
[3] Handb. der Palæont., vol. ii, p. 476.
[4] Paléont. Franc., Ter. Cret., vol. i. atlas. pl. 59, fig. 3.
[5] Trans. Royal Soc. Canada, vol. x, sect. iv, p. 118, pl. xi, figs. 3-5.
[6] Ib., p. 117, pl. xi, figs. 2, 2 *a* & *b*.
[7] Bull. Geol. and Geog. Surv. Terr., vol. i. No 4, p. 370, pl. vi, figs. 1, 1 *a-c*.

With the permission of Mr. Deans, the types of the two species described in this paper have been presented to the museum of the Geological Survey by the members of the Natural History Society of British Columbia.

EXPLANATION OF PLATE VII.

OLCOSTEPHANUS (ASTIERIA) DEANSII.

Fig. 1.—Side view of the only specimen collected.

1a.—Outline of the same, from another point of view, to show the proportionate breadth of the shell and probable shape of its aperture.

HOPLITES HAIDAQUENSIS.

Fig. 2.—Side view of the only specimen collected.

2a.—Another view of the same, to show the characters of the peripheral region, near the aperture.

2b.—Front view of the same, in outline, to show the shape of the aperture, etc. All the figures of natural size.

NOTES ON THE DEPLETION OF THE FUR-SEAL IN THE SOUTHERN SEAS.[1]

By FREDERICK REVANS CHAPMAN.

In a communication which I addressed to Prof. T. J. Parker, F.R.S., on September 24th, 1891, I gave such facts as I then had at command on the subject of the practical extinction of the fur-seal of New Zealand. I am now in a position to add considerably to this, and to supplement it with information respecting the fate of this animal in the Australian seas. If more were needed, I think that it might be obtained by further research, but this would be difficult and would take much time, and as I have no reason

[1] Mr. Chapman's paper, here printed, was written by him in response to enquiries on my part respecting the fur-seal and methods of sealing in the Australasian region. These enquiries were in the first place addressed to Prof. T. J. Parker, F.R.S., of the University of Otago, Dunedin, N.Z. Prof. Parker referred to Mr. Chapman as likely to be well informed on the subject, and obtained from him a memorandum which was printed as an appendix to the Report of the British Behring Sea Commission. At a later date, and too late for inclusion in the report mentioned, Mr. Chapman favored me with the present more detailed paper, embodying the result of much enquiry on his part. This paper, it is

to think that it would support any conclusions differing from those toward which the evidence now collected tends, I think it as well to communicate what I have.

All early writers on New Zealand, Tasmania (Van Diemen's Land) and the southern part of Australia agree in describing the fur-seal as very plentiful in these regions.

Captain Cook (1770), after circumnavigating the North Island of New Zealand, passed down the east coast of the South or Middle Island. When in latitude 46° 31′, off this coast, he remarks: "This day we saw some whales and seals, as we had done several times after having passed the strait" (Cook Strait); "but we saw no seal while we were upon the coast of Eahienomawe" (North Island). On his second voyage (1773) he visited the west coast of what subsequently became the Province of Otago. He refers to the seals here as follows: "A gentleman killed a seal, one of the many which were upon a rock." And next day writes: "We touched at the seal rock and killed three seals." And again, in the same vicinity: "Rowing out to the outermost isles, where we saw many seals, fourteen of which we killed and brought away with us; and might have got many more would the surf have permitted us to land with safety." A few days later he writes: "We could only land in one place, where we killed ten."

The great navigator and others who followed him killed seals only for food. This, too, had been the practice of the Maoris. Mention of seals is constantly found in traditions relating to the southern portion of the South Island (east coast). Mr. T. Sarata, a Maori member of Parliament, tells

believed, will be of general interest, as it relates to a chapter of history and exploration of which few records have seen the light.

It must be remembered, in reading Mr. Chapman's paper, that the pursuit of fur-seals in the Southern Hemisphere has been entirely confined to the killing of these animals on shore, at their breeding-stations. "Pelagic sealing," as now carried on in the North Pacific, has never been practised in the South; where vessels have been employed merely as the means of reaching the otherwise inaccessible resorts of the seals. Thus Mr. Chapman's observations, in so far as they bear on the question of the preservation of the fur-seal of the North Pacific, go to show the extreme importance of protecting the littoral breeding resorts of the animals from all disturbances —G. M. DAWSON.

me that his ancestors, living about Otago Heads, used annually to make expeditions to Cape Saunders to catch young seals after the breeding season. I also find seals' bones in ancient Maori middens in sufficient numbers to indicate that the animal was once a staple of food here. The natives had neither methods nor motives which could result in the extermination of seals; indeed the parts of the coast where these were and still are most plentiful, were and yet remain uninhabited.

Such records as we have of the transactions on the coasts of South Island in the early part of the century tell us that sealing was the first industry; the sealers preceded the whalers, as the whalers preceded the "flax"[1] traders, and these in turn were succeeded by the colonists. Of the sealers and their doings we have little actual record in the colony which has since sprung up, but what we know we learn mainly from the older colony of New South Wales and from the books of travellers. More may doubtless be learned from England and North America, whence came a large number of the sealing vessels. As it is, the information has to be sought from scattered sources. It will be readily understood how slight is the acquaintance of the colonists with seals and their history, when it is considered that in the South Island, which the seals formerly inhabited, the west coast is almost unoccupied along a great part of its extent; while on the east coast, which is fairly populated, the seals became almost extinct prior to the permanent settlement of the country. The west coast is only inhabited as far north as lat. 44°.

As early as 1846, *i. e.*, six years after the foundation of the colony, when Major Heaphy and Mr. Brunner, the explorers sent by the New Zealand Company, passed down the coast by land, they found a few seals, which were regarded with curiosity, on the Steeples at Cape Foulwind. Local tradition referred to the already almost mythical times of the sealers and their doings here. The explorers,

[1] *Phormium tenax.*

referring to the Maoris at the nephrite cutting village, Kararoa, say: "Of these only the old man and woman had ever seen a white man. They remembered the sealers." Even at that date, however, it was worth while to visit the "rookeries" occasionally. Two years before the exploring party went down, 150 sealskins had been obtained at the Steeples. Another point had not been visited for ten years, and it is mentioned that fifteen years earlier a sealing vessel had been lost, and those of her crew who escaped had been murdered by Maoris.

I am unable to give the northward limit of the seals. They were extremely plentiful in Bass Strait, in lat. 38°, and on this island at least as far north as Cape Foulwind, lat. 42°. While not unknown in the North Island, they were evidently rare there. Mention is made in a book of a vessel coming from the Fiji Islands with sealskins, but, if this is not a mistake, I suspect that this locality was given out to mislead competitors, the vessel having really come from some previously unvisited spot in the vicinity of New Zealand, which it was thought undesirable to make known.

Some idea of the number of seals in suitable localities will be gathered from a few facts which may be mentioned.

New Sonth Wales was colonized in 1788, and very soon after, whalers and sealers began to frequent the neighboring seas. In that year Messrs. Enderby's ship, the *Emilia*, rounded Cape Horn, and first carried the sperm whale fishery into the Pacific Ocean. As early as 1793 an American sealer, on his way to his own cruising grounds, called at Sydney and expressed surprise that they had no small craft on the coast, as he had observed a plentiful harvest of seals as he came along.

The insularity of Van Diemen's Land was discovered by Messrs. Bass and Flinders in 1798. In the vicinty of Bass Strait they met the sealing vessel *Nautilus*, which obtained 9,000 seals on that cruise. Seals of several species in enormous numbers were seen. Mr. Flinders likens the scene to a crowded farmyard, and Mr. Bass "had to fight his way

up the cliffs of the island against the seals." The American sealers getting scent of the business, with customary energy, poured into these seas and joined in the scramble. The captains of American vessels being disinclined to respect the local customs regulations, gave a good deal of trouble, and were accused of disturbing the seal fisheries. They probably secured a share of the skins of which no record would appear in Colonial or British customs returns.

In 1802 Captain Campbell, on an island off King's Island, in Bass Strait, killed in ten weeks (from 10th March to 27th May) 600 sea elephants and 4,300 seals. In the same year two French vessels came there seal hunting, but were warned off by Governor King. Van Diemen's Land, now named Tasmania, was settled in 1803, and at a very early date escaped convicts and lawless, runaway sealers began to infest the islands of Bass Strait, ostensibly, and sometimes actually, engaged in sealing. Regular shore gangs were formed which occupied the islands of the strait in sets of ten or twelve. They were tendered by small vessels, which brought provisions and carried away sea-elephant oil and sealskins in abundance. They employed Tasmanian native women to swim out to the rocks, imitate the motion of the seals, and thus take and slaughter them. Before long some of this class, as well as others of better repute, began to find their way to New Zealand. As early as 1792 Messrs. Enderby sent a sealing party to Dusky Sound, by the *Britannia*, and procured 4,500 skins. Jorgen Jorgenson, afterwards known in history for his revolt in Iceland, was upon the coast of New Zealand in 1804. He went down in charge of a small vessel from Port Jackson. "We killed," he says, "several thousand of these harmless animals, and it was quite astonishing with what eagerness the sailors entered into the pursuit, knocking down the animals with their clubs, stripping them of their skins and pegging them out to dry or salting them down in casks, with the greatest zeal and perseverance. At that time these skins were sold in London at a guinea each. We filled our small vessel and returned to Sydney."

The following entries of sealskins are recorded at Sydney. The *Sydney Gazette*, October 14, 1803, notes the arrival of the sealer *Endeavour*, Captain Oliphant, with 2,200 sealskins from New Zealand, six months out. The *Endeavour* brought into Sydney from March 9, 1803, to May 28, 1804, 9,514 sealskins, worth 20 shillings each, and the schooner *Surprise*, from March 11, 1809, to September 15 of the same year, 15,480. During the years 1803 and 1804 upwards of 36,000 sealskins were obtained from the islands of Bass Strait, the slaughter being carried on without regard for sex or season. Some of the above figures probably overlap, as my information does not always state where the seals came from, and it is evident that there are long gaps without information.

The *Scorpion*, 14 guns, left England in 1803 with letters of marque. She captured two French whalers with full cargoes. Whether she got sealskins from them I do not know, but she entered Sydney early in 1804, after a visit to New Zealand, with 4,759 sealskins. Her master, Captain Dagg, leaves his name in Dagg's Sound, on the west coast of Otago. The sealer *Sydney Cove* landed a party at the South Cape (Stewart Island) in 1806. These men were murdered by the natives, save one who married a chief's daughter and got to Sydney in 1820. In 1813 the schooner *Governor Bligh*, Captain Snow, brought to Port Jackson 14,000 sealskins, after a sixteen months' cruise about New Zealand. She also brought back ten men who had been landed there by a vessel which was to return for them, but was never heard of. This occurred again the same year, when the brig *Perseverance* brought away four men similarly left four years before at Solander Island, in Foveaux Strait. Her take is not mentioned. The fact of these crews being left shows that there were parties constantly at work. The figures are perhaps somewhat confused, but they probably altogether understate the results. They sufficiently show at least that there were then rich hunting grounds on the coasts of Australia, Tasmania and New Zealand.

J. S. Polock, in his work "Travels and Adventures in New Zealand."[1] says: "Some fifteen years back seals were very prolific [plentiful] on the southerly parts of the country, many shore parties procuring 100,000 skins in a season. So few are now procurable that a single vessel employed solely in this trade would make a losing speculation. The favourite grounds frequented by these animals was the whole of the west coast of the Island of Victoria (Middle or South Island), from Cape Farewell to the South Cape, including the rocks called the Traps, the Snare Islands, Antipodes Islands, Bounty Rocks, Auckland Isles and the Chatham Groups. All these places were infested by the various phocæ, which have since been annually cut up." This writer, though his figures are astonishing, is recognized as one of the safest authorities on subjects relating to the early days of New Zealand. Dumont D'Urville, in 1830, notices the great decline of the seals in recent years.

Sealing was, in the early years of the century and probably up to 1830 or even later, pursued with declining success in Foveaux Strait, on the coast of Stewart Island. Mr. East, in his evidence before a select committee of the House of Commons in 1844, says: 'The seals, what few there are, are in the southern part of the island, near the settlements of the Middle Island. Formerly they abounded, but they have been attacked so by the Australian colonists in times past that they have nearly left."

Old narratives, sometimes founded on fact, sometimes mythical, tell strange tales of those wild days. Tommy Chaseland, a noted sealer and afterwards a famous headman of the later whaling days, was the son of an Australian woman and a white man. He navigated his open sealing boat from the Chatham Islands to New Zealand in the stormiest of seas, and lives in the memory of a few of the oldest inhabitants as the hero of numerous bold adventures. Probably the cold seas of the north teem with bold spirits of this kind.

On all these southern and eastern coasts, however, a seal

[1] London, 1838, vol. i, p. 316.

is now so rare an apparition as not to be recorded once in ten years. In the sounds of Western Otago, then the most prolific sealing ground, they are still occasionally found, being known to breed on a few very inaccessible rocks in that uninhabited region. Fifteen years ago Captain Fairchild, of the Government steamer *Hinemoa*, himself an old northern sealer, showed me his charts on which were marked several of these "rookeries," but depletion has progressed since, partly through the operations of the Maoris, who occasionally pass round the coast in whaleboats from Foveaux Strait, and partly from the fact that the coast is now much more visited and disturbed than formerly.

Though the information which I have got together is of a fragmentary character, it sufficiently shows that sealing was an active pursuit in the southern part of New Zealand, and that numerous sealing vessels obtained full cargoes there, while for nearly half a century the few surviving seals have been pressed nearer and nearer to the point of extermination without being systematically pursued. The islands lying off the coast of New Zealand, however, have proved, relatively at least to their extent, vastly richer in seals than the mainland. Six groups of small islands lie to the south of the latitude of New Zealand.[1] The Snares were discovered by Vancouver late in the eighteenth century. They lie sixth-three miles from Stewart Island. Seals are still found there in small numbers, and were, I have no doubt, once numerous, but the group is so very small that their extermination must have been an easy matter. The Auckland Islands, in lat. 50° S., are about as long as the Isle of Wight, but much cut up by inlets, and with a precipitous southern and western coast, with numerous sea caves capable of sheltering seal "rookeries." They were discovered in 1810 by John Benton, a whaling captain hailing from Sydney, connected with the house of Enderby. They were found to be crowded with seals, and for many years afforded

[1] For further interesting particulars respecting these islands, see a paper by Mr. Chapman entitled "The Outlying Islands South of New Zealand," Trans. New Zealand Inst.," 1890, p. 491.

a good sealing ground. After a while they seem to have been abandoned for long intervals and revisited with varying success. An attempt was made to colonize them in 1850, which failed after two years. During this period sealing was not pursued. It is impossible to ascertain with any degree of accuracy what number of skins they have supplied, but this much is known that even as lately as 1885, when a party of shipwrecked sailors was found on these desolate islands, they were rescued by a party of white and half-caste sealers, who took them to the sealing grounds. One of them published in the Melbourne *Argus* an interesting series of articles, which showed that numerous "rookeries" were still full, and were systematically visited by these poachers, who were lowered over the high cliffs by their companions by means of ropes. Though I visited this coast a few years later, on a bright, sunny day, with a calm sea, I can imagine no more desolate or dangerous scene, nor a safer refuge from everything but human ingenuity. The fruits of this illicit sealing were gathered by a member of Parliament, and a still higher personage was not free from suspicion. For many years a close time had been proclaimed by the New Zealand Government, which, however, does not possess means adequate to the suppression of this illicit sealing. A short season was opened a few years since, when sealing expeditions were fitted out and all available seals, irrespective of age or sex, were slaughtered, in the hope that the closing of Behring Sea would cause a great rise in prices. As, however, the prices were very low, and the sealers settled disputes with the owner of the vessel by stealing the skins, the result was disappointing. I believe about a thousand skins were obtained at the various islands, chiefly at this group.

Sea-lions, which are said to be quite useless, are very numerous at the Auckland Islands.

Campbell Island, lat. 53°, was discovered by Hazelburg, in a whaling vessel fitted out by the Campbells of Sydney, in 1819. It is a bold, round island of small size, some hundreds of miles from any other land. It has in times past

yielded large quantities of seals. Numerous vessels visited it soon after its discovery, and shore parties lived there for considerable periods. Portions of wrecks and graves of sailors attest these facts. An American poaching vessel which came out to visit it during the close season, ten years ago, met with disappointing results and lost a boat's crew there. Recent cruises have yielded a few seals in this field.

Macquarrie Island, which lies outside the jurisdiction of New Zealand, in lat. 55°, is now the home of countless great king penguins and of numerous sea-elephants. This was the most remarkable sealing ground in this part of the world. It is 650 miles from the Bluff Harbour and 800 from Tasmania, to which it is politically attached and the Government of which now prohibits the destruction of its native animals and birds. It is not known who discovered it, as the discovery by some Sydney sealing vessel, which occurred about 1811, was evidently kept a secret at first. I suspect that the entry of sealskins from Figi already mentioned was part of the process of keeping the secret. It is said that this small island, not more than twenty-five miles long and less than half that width, yielded to the discoverers no less than 80,000 seals. There is evidence that the pursuit was continued in later years, until dogs brought there by shore parties, destroyed the young seals and exterminated the race. This was facilitated by the fact that there are no considerable cliffs, the herbage everywhere dipping nearly to the sea. I may mention that Professor Scott of the Otago University, who visited the island in 1880, found that the fur seal was then absolutely unknown there; and though shore parties have worked there pretty nearly ever since boiling down sea-elephants, and several kinds of seals are seen, the fur-seal has never reappeared. This appears to support the statement made to me by Captain Fairchild that the fur-seal of these seas returns to breed at its own station and that it is useless to try and shift it to another.

It is to be observed that no land lies south of Macquarrie Island in this region until the ice-bound antarctic land discovered by Ross is reached. A spot marked as Emerald Island on the maps has no existence, nor has Royal Company Island, south of Tasmania. Vessels, however, on the homeward voyage are occasionally driven to Dougherty Island, between New Zealand and Cape Horn, and there it is asserted seals are seen in large numbers. Presumably the seals go south to the ice in summer, as they are not then seen at the various islands. The penguins, however, must go south in winter, as they are seen at the islands in enormous numbers in summer and are absent in winter. The extremely limited extent of the land below the ice line no doubt contributed to the ultimate destruction of the seals of Macquarrie Island.

Antipodes Island, discovered by Pendleton in 1800, a solitary mountainous island surrounded by steep cliffs and only three miles in length and breadth, was also the home of numerous seals. It is known that it was formerly visited by sealers. A man who spent six months there some years since, obtained no seals. Captain Fairchild has never seen seals there, but the recent open season led to its being visited with some result.

Bounty Islands, discovered by Captain Bligh on the outward voyage of the *Bounty* in 1788, form a small group of rocky islands quite without herbage or water and covered with enormous numbers of sea-birds. This group was a famous sealing ground. A sealing party remained here five months in charge of the once famous Maori chief Duaterra, about 1807. Their stay in this desolate spot was unduly prolonged and two Europeans and one Tahitian died of the privations to which they were subjected. They, however, took 8,000 skins. It is evident that numerous other parties of whose doings there is no record visited this place, which even during the late open season seems to have yielded some hundreds of seals, though the total area of rocky surface is not much more than 100 acres. I saw no seals when I visited these rocks a few years since, but the enormous

numbers of penguins swimming in the sea and sitting on the rocks—computed at a low estimate at several millions—attests the presence of a plentiful food supply.

A seventh group is the Chathams, discovered at the end of the last century by Lieut. Broughton. This group, which is situated in the latitude of New Zealand (43°), was inhabited by numerous natives of a primitive Polynesian race called Moriori, thirty of whom survive. About 1835 it was conquered by the Maoris, who now number 300, and to whom are added an equal number of Europeans. It has from the first been a sealing ground. Several shore parties lived here at various periods, and the outlying rocks are still visited by a small number of seals. Of the doings of sealers here I have found it impossible as yet to get records, but it was recognized as a new field. These islands have a good climate and soil, and were, until recently, for many years the headquarters of the now abandoned sperm whale fishery.

When the Europeans commenced to hunt seals on the coast of New Zealand they also found whales in immense numbers. The coasts swarmed with black or inshore whales, and the deeper waters, even near the land, abounded in sperm whales. The great sea now known as the Tasman Sea, between Australia and New Zealand, was called the Middle Ground, and was throughout its extent a whaling ground. It was found worth while to equip whaling vessels both from Sydney and from England. In addition to these were many from America and France and some from other countries. The very first whaling fleet which sailed from Sydney brought in a large catch, and reported the amazing fact that they had sighted 15,000 whales. Mr. Wm. Chapman, who visited New Zealand with the Governor of Norfolk Island, in 1793, describes the number of whales off the north of New Zealand, where he saw several whale-ships successfully cruising. The crew easily killed a whale, apparently for pastime. The whale fisheries were continued with activity until after 1840, but from that date a great decline in results is noticed.

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As points of analogy occur between whaling and sealing in the Southern Hemisphere, it will not be out of place to add a few words on the whaling industry, the last ship connected with which withdrew from the waters a year or two since. Some statistics have been preserved as to the whaling operations north of Banks Peninsula for a few years. They are imperfect, as they relate to the transactions of one firm only, but they give some idea of the magnitude and the course of the trade. Each whale yields five or six tuns of oil.

Year.	Whales caught.	Oil in tuns.	Year.	Whales caught.	Oil in tuns.
1829	(?)	120	1837	75	360
1830	do.	143	1838	156	725
1831	do.	152	1839	134	642
1832	do.	115	1840	90	429
1833	do.	284	1841	57	285
1834	do.	424	1842	35	163
1835	69	502	1843	30	151
1836	70	410			

The foregoing was entirely the work of shore stations on a few hundred miles of coast. The figures do not take into account the catch of ships, even in the same localities. Thus, in 1834, one vessel, the *Columbia*, took 200 tuns in the harbour of Otakson (Otago). In 1835 four or five vessels fished in this harbour. During 1841, 1842 and 1843 nineteen vessels, principally French, entered the harbour. But all this was exceeded by the operations in Cook Strait and in parts of the North Island. The Bay of Islands became, like Honolulu in later times, the rendezvous of a great fleet of whaling vessels. The fragmentary statistics which have come to hand amply show this; yet the vessels only entered the harbours at certain seasons, and many of them wholly avoided harbours, as, once there, they had no law to prevent the desertion of seamen.

The French made some sort of protest against the destructiveness of shore stations, but there was no recognized sovereignty save a shadowy dependence on New South Wales, and there was no law of any kind prior to 1840. It

is to the operation of shore parties, destroying and disturbing the cow whales in the breeding grounds, that I attribute the extinction of the whales. The sperm whale, which lives more constantly in the deep sea, lasted longer and lingers still. At this once famous whaling station one whale —possibly two—has been killed in the last twenty years. The boats have rotted on the beach; it is not worth the while of the Maori owners to look after them. With the the town of Dunedin in the bay, numbering 45,000 inhabitants, and a trade of some millions annually, the survival of the whales could not be expected.

I cannot but attribute the depletion of the seals to the same cause. They are very timid, and as is the case with all timid creatures disturbance on the breeding grounds is fatal to the maintenance of the race. Disturbance in this case has taken the form of reckless slaughter. There could be no hope of preserving the seals on the east coast, which is now settled and is rapidly becoming well peopled. On the wild west coast they could only be preserved by stringent laws judiciously administered. There are reasons which lead me to conclude that once or twice in recent years, when left undisturbed for a time, they have increased in certain places. The comparatively large number obtained in 1891 caused some surprise to experts, and this fact may be taken as some evidence of increase. Such an increase can, however, only lead to partial restoration of the seal fisheries on the uninhabited west coast and on the islands which are probably useless for other purposes, if great care is used to make the protection effective.

Dunedin, N. Z., March 22, 1893.

Some Notes on the Rideau Canal, the Sources of its Water Supply, and its Early History.

By A. T. Drummond.

A somewhat careful investigation into the nature of the country bordering on the Rideau Canal, as well as of the lakes on its course and of its water powers—all inconnection with a line of railway now being surveyed—has led to my

ascertaining some facts of interest which I desire to here mention. It has further occurred to me that here also might be a fitting place for a short resumé of the facts—almost unknown now in this country—connected with the inception and construction of the canal. These facts I have abbreviated from the extensive manuscript notes—taken from the Dominion archives and other sources, as well as from personal recollection—of Mr. Andrew Drummond of Ottawa, whose association and close family connection with two of the leading builders of the canal and personal acquaintance, formed in 1832, with others who planned its construction, enables him to speak with not only some interest, but even some authority.

The canal may be divided into the river and the lake divisions, the former comprising the Rideau River which was the original outlet to the Ottawa of the Upper and Lower Rideau Lakes lying beyond Smith's Falls. The lake division, besides these two lakes, includes Mud, Clear, Indian, Opinicon, Sand, Whitefish and Cranberry Lakes, to which may be added the long artificial lake, known as the "drowned lands," created between Washburn and Kingston Mills, by the erection of the Kingston Mill's dam. The waters of Upper Rideau Lake form the summit level of the canal system, and are admitted by the locks on either side of the lake to the Ottawa River slope or to the St. Lawrence River slope as the traffic on the canal requires. The immense importance of keeping a sufficient supply of water in this lake is so obvious that every means should be taken to husband the waters of its feeders, Clear, Wolfe and Sand Lakes, which empty into it at Westport. The forest country around these outer lakes should be kept, as far as possible, in its virgin state by protecting it from forest fires and absolutely withdrawing it from settlement, in order to hold back within these forests the accumulations from the melted snow and the rain which otherwise will be too quickly drained off into the lakes. Were Upper Rideau Lake allowed in midsummer to fall seriously in level at the

locks, the whole canal would be rendered practically useless.

The depth of water in the different lakes, according to old navigators and fishermen, is not very great. The lakes on the St. Lawrence slope do not, it is said by them, exceed 100 feet in depth. My own soundings in the upper half of of Lower Rideau Lake at points where our fisherman indicated were the greatest depths, gave 114 feet as the maximum, but in the Rocky Narrows nearer Oliver's Ferry on the same lake, the lead has, it is asserted, found the bottom at about 200 feet.

The waters of these in land lakes are in similar depths considerably colder than those of Lake Ontario. On the 6th July, 1893, at noon, under the conditions of strong sun, with a few light clouds and a comparative calm, the thermometer readings, at one half a mile from Grindstone Island, in Lower Rideau Lake, gave the following temperatures of the water:

1 inch below surface			77° F.
2½ feet	"	"	74° F.
102 "	"	"	47·5° F.

Half an hour later, at another locality, a quarter of a mile farther fromthe island, and with more clouds in the sky, the record indicated:

1 inch below surface			76° F.
2 feet	"	"	74·5° F.
96 "	"	"	45° F.

In the Ontario waters, at this period, with their temperature raised by constant accessions from Lake Erie, which not only lies further south but is also very shallow, the mercury in the main channel opposite Kingston stood at 62·25° in 11 fathoms in one locality, and at 53° in 17 fathoms in another.

In Cataraqui Bay, where the waters of the canal join Lake Ontario, there is what old navigators call "a tide" of ten inches to one foot, caused evidently by the frequent westerly winds on Lake Ontario forcing the water to a higher level in the gradually contracted area forming the

bay. Capt. Fleming, of the steamer *James Swift*, informs me that it comes and goes, and is so well known that when his boat happens to ground, through missing the channel, he simply waits for the "tide" to again float it. During a continuous calm of two or more days the rise and fall cease.

It is an interesting fact that the summit levels of the different systems of lakes which are the sources of the water supply of the Rideau Canal lie chiefly in the townships of Bedford and Loughborough, and within a very moderate distance of Lake Ontario. The headwaters of the Loughborough Lake system are within seven miles of Kingston; Knowlton, the uppermost of those lakes which find an outlet on the canal at Mud Lake, is within thirteen miles of the same place; whilst Bobb's Lake (a corruption, perhaps, of Robb's Lake), the most important of the higher levels of the River Tay system, whose waters eventually reach the Ottawa, is also situated within twenty-five miles of Kingston. The low, broad ridge of gneiss which connects the Laurentian rocks of New York State with the main range in Canada, forms the watershed here of the streams falling into the Ottawa, on the one hand, and the St. Lawrence and Lake Ontario, on the other. The strata are, however, thrown up into very numerous subordinate ridges, which lie here in directions generally north-east and south-west, and somewhat parallel to each other. These ridges, prolonged far to the south-west towards Kingston, have led to the formation and extension of lake basins in that direction. Those who planned the Rideau Canal, notably Col. By, showed their engineering skill in taking advantage of the number and different levels of these lake basins to procure an adequate supply of water for navigation on the summit level as well as on both slopes, causing the waters sometimes, as in the Loughborough Lake and the Devil's Lake systems, to almost double on themselves.

This great water system, including in it fifty-three lakes which are from one to fifteen miles long, has another peculiarity, that these lakes lie, with only four unimportant

exceptions, on the west and north-west side of the canal. Between Kingston Mills and the mouth of the Tay the canal lies, as it were, on the side of a gentle slope from the south-west, the lakes thus on that side discharging into it, whilst those on the other find their outlet chiefly through the Gananoque River to the St. Lawrence.

We are apt to regard the townships of Storrington, Loughborough and Bedford and the east half of the township of Hinchinbrooke, all in the county of Frontenac, as unattractive for settlement, and to assume that when the pine and spruce are removed from their forests there will be nothing left in this somewhat rugged country but the possibility of minerals. It is consoling, however, to think that all the lakes which, walled in by heights of verdure-clad gneiss, picturesquely stud these townships in every direction, are the great reservoirs from which chiefly is drawn the supply of water needed to keep the Rideau Canal navigable as well in its course to Ottawa as in its course to Kingston. Had the great forces of nature not placed these Laurentian ridges in positions to form lake basins between them, and left the country rugged and unattractive, so that the virgin forests might largely remain and in their depths hold back the waters from being too quickly drained away, it would be hopeless to maintain uninterrnpted navigation on the canal.

The more that consideration is given to the subject, the more reasonable does it seem to be to regard these Laurentian ridges as having long preceded the ice age, and to view the lakes, scattered over this archæan area here in such apparent, picturesque confusion, as in reality occupying still older lake basins whose position and general direction was due to the presence of the ridges, and through which guided in their course by the lie of the ridges, the glaciers during the ice age flowed. These ancient ridges have suffered from the decomposing forces of perhaps centuries of the growth and decay upon their surfaces of plant life, of the extremes of heat in summer and cold in winter, and of

the wearing effect of storms and floods, and possibly may have felt the force of even former ice periods, and their worn shapes must not be altogether attributed to post-pliocene times.

On its western and northwestern sides the canal is fed by seven systems of lakes. Two of these, the River Tay and Black Lake systems, supply Lower Rideau Lake, and eventually through the Rideau River, reach the River Ottawa. One system, the Wolfe Lake system, joins Upper Rideau Lake, the summit lake, and is therefore tributary to both the St. Lawrence and the Ottawa slope. The other four systems furnish the supply of water for the St. Lawrence slope, and also are through the outlet, in reality now a great waste weir, at Morton, the actual headwaters of the Gananoque River. On the easterly side of the canal, three or four small lakes form sources of supply, but of these only Irish, Otter and Bass Lakes have any importance.

The comparative freedom from water courses is a singular feature of the country bordering on the Rideau River after it leaves the lake systems. With the exception of the River Goodwood (or Jock), Irish Creek and the south branch of the Rideau River, not one of which has pretensions to being more than a creek, the Rideau has practically no tributaries in this length of about 70 miles.

Considerable confusion appears to exist on the maps as to the locality, name and outlet of many of the lakes in Frontenac county, and it is therefore desirable to briefly refer to the lakes forming each system, my authority being one of the original charts on file in the Department of Railways and Canals at Ottawa, which Mr. F. A. Wise, the superintending engineer has kindly allowed me to consult.

River Tay System.—Long, Eagle and Elbow Lakes in the townships of Hinchinbrooke and Olden, are at the headwaters of this system. In Bedford, it is joined by Bobs, (probably, originally, Robb's), Crown or Crow) and Green Lakes. Entering South Sherbrooke as the River Tay, it has, added to it, the waters of Farrens and Silver Lakes, and

then widens into Christie's Lake. Grant's Creek connects it near Perth with Pike, Second and Third Lakes and near its outlet into Lower Rideau Lake, it receives the waters of Otty Lake.

Black Lake System.—Black Lake in North Burgess and a small lake beyond it in North Crosby, constitute an independent system which is also tributary to Lower Rideau Lake.

Wolfe Lake System.—Clear Lake (No. 2) in Bedford forms the summit, but Wolfe Lake and Sand Lake, the latter wholly in North Crosby, are the principal reservoirs and supply Upper Rideau Lake at Westport.

Devil's Lake System.—Knowlton, Mud, Otter and Desert Lakes in the township of Loughborough are at the headwaters of this system. Desert Lake is joined from Bedford by the waters of Carter (or Garter), Canoe and Elbow (No. 2) Lakes and the system then expands into Birch Lake which also receives the outflow from Long Salmon Lake in the township of Loughborough. Mud (No. 2) and Devil Lakes in Bedford are further expansions of the system, which, after including Loon Lake in North Crosby, eventually reaches the Canal system at Mud Lake proper.

Buck Lake System.—Draper is the largest of a small group of lakes in the township of Loughborough at the source of this system. These along with Clear Lake (No. 3) and four smaller sheets of water are tributary to Buck Lake, which lies partly in Bedford, and whence the waters flow by the Mississagua River to Mosquito Lake in South Crosby, from which they reach Mud and Indian Lake on the Canal route.

Rock Lake System.—This system takes its rise in the township of Loughborough but its larger sheets of water, Expedition, Upper Rock and Rock Lakes, are in Storrington. It is tributary to the Canal system at Opinicon Lake.

Loughborough Lake System.—This system is tributary to the Canal near Brewer's Mills, and includes Troy, Little Cranberry and Dog Lakes, all in Storrington, and Loughborough Lake which is situated partly in the township of Loughbor-

ough and partly in Storrington, and is the largest of the Rideau Canal feeders.

As, originally, Cranberry Lake—then known as Cranberry Marsh—appears to have had a connection with Whitefish Lake, the waters of this system may, in times of flood, have been also tributary to the Gananoque River and have reached the St. Lawrence at Gananoque as well as Lake Ontario at Kingston.

The duplication of names should be avoided by the Government renaming some of these lakes, the scanty population and small interests presently involved, readily admitting of this being done. Other defects in nomenclature also need pressing attention.

EARLY HISTORY OF THE CANAL.

At the close of the war between France and Great Britain which resulted in French Canada becoming a British Crown Colony, the Ottawa valley had a few settlements as far up the river as Carillon on the north side, but the south side was still an almost unbroken wilderness. In 1783, the British Government, in pursuance of its policy of settling the United Empire Loyalists from the United States, and the disbanded soldiers, upon free grant lands in Canada, sent Lieutenants French and Jones to explore the country, on either side of the River Ottawa. Lieutenant French proceeded up the river as far as the Rideau Falls and then diverging inland, followed the Rideau River to the Rideau Lakes. Coursing his way through the net-work of lakes met with beyond this, he at length reached the Gananoque River, down which he went to the St. Lawrence. Lieutenant Jones pushed through the country bordering the River Ottawa, along its northern banks, until he reached the Chaudiere Falls, where he crossed to the other side and returned to Montreal by the south bank. Both officers found a large amount of land available for settlement. No special official action appears, however, to have been taken, at the time, on these reports, and the course of settlement for

years afterwards continued rather to be directed to the valley of the St. Lawrence.

The construction of a canal to connect the River Ottawa with Lake Ontario formed the subject of discussion from time to time after this, but it was not until the breaking out of the war between the United States and Great Britain, in June, 1812, that the urgent necessity for such a canal became apparent both to the British Government and to the Canadian leaders. The transportation of arms and supplies from Quebec and Montreal to the upper lakes by way of the St. Lawrence River involved great exposure to the enemy along the extended frontier of New York State. The expense arising from the Government's endeavor to avoid this exposure was enormous. The transportation of a 24-pounder cannon from Quebec to Kingston alone cost nearly one thousand dollars. The earliest official document dealing practically with the subject of a canal appeared on the 29th December, 1814, in the shape of a letter from Sir George Prevost, in command in Upper Canada, to Lieut.-Gen. Sir Gordon Drummond, at Kingston, enclosing some plans and reports, and asking for opinions thereon and for further information. Sir Gordon's reply, transmitting reports from three of the local officers, gave his own opinion that the difficulties would be immense and the expense enormous.

On the restoration of peace, however, Sir Gordon Drummond was instructed by Lord Bathurst, under date of 10th October, 1815, to get "estimates of the expense of the Lachine Canal, and of the Ottawa and Rideau being made navigable, in order that His Majesty's Government may decide as to the propriety of undertaking these works, either separately or simultaneously." Accordingly Lieut. Jebb was, early in 1816, directed to ascend the Cataraqui River to the chain of lakes and thence continue down the Rideau River to the Ottawa, and to return by the same route, reporting on the land available for military settlements and on the navigation for batteaux. His report

recommended certain dams to be constructed and certain channels on the Rideau River to be cleared of obstructions. It was immediately subsequent to this that the military settlements of Perth and Richmond were laid out, but not until 1819 that construction of canals was actively undertaken, by the Imperial Government. In this year the Grenville Canal was begun by the Royal Staff Corps, although not completed until 1833. In 1821 the Carillon Canal was similarly commenced by the Staff Corps and completed in 1834; whilst the Lachine Canal was undertaken by the Lower Province, with some aid from the Imperial Government, and finished in 1824.

In 1821 the interest of the people of the Upper Province was thoroughly aroused, and a commission, under the presidency of Hon. John Macaulay of Kingston, was appointed to consider the improvement of the internal navigation of the Province. The commission reported on the Rideau Canal on the 5th October, 1825, giving three estimates of cost; that for a canal 5 feet deep, and with locks 80 feet long by 15 wide, being £145,802 stg. This report was apparently at once transmitted to the British Government, which in the same year sent out a commission, composed of Sir J. C. Smyth, Sir G. Hoste and Major Harris, C.E., to enquire into the cost of construction of a canal on the same scale as the Lachine Canal, which had been made 5 feet deep, and with locks 108 feet long by 20 feet wide. This commission in its report estimated the cost at £169,000 stg., and on this report being received by the Home Government the construction of the Rideau Canal was determined on.

On 30th May, 1826, Lieut.-Col. By, R.E., arrived at Quebec from England, with instructions from Gen. Mann, inspector of fortifications, to superintend the building of the canal on the lines laid down by the Imperial commission. Foreseeing the possibilities of steam on the great river systems of Canada, and its importance on the canal as a motive power instead of horses, as contemplated by the

commission, he, on the 13th July, 1826, urged Gen. Mann to adapt the work to the use of steam power, including the enlargement of the locks to admit vessels of 130 feet in length. This was vigorously opposed by Sir J. C. Smyth, with the result that Col. By was directed to commence construction on the original lines.

About the middle of September, 1826, Col. By and his assistant, Lieut. Pooley, reached Hull, and shortly afterwards inaugnrated the work by laying out the entrance of the caual at "Sleigh Bay," its present location under the shadow of the eastern block of the parliamentary buildings. The importance of the occasion was signalized by the arrival, a few days afterwards, of the Governor, Earl Dalhousie, who formally approved of the location selected.

The first steps taken in actual construction consisted in the building of a bridge across the Ottawa River fronting the Chaudière Falls, on the site of the present iron bridge, in order to get in material and supplies, the erection of barracks for the men and magazines for stores, and the construction of a road from the Chaudière Falls to Long Island, on the Rideau River. These works were completed by the close of 1827, excepting the bridge, which was not opened until a year later. In the construction of these works we first meet with the names of the men who built the more important structures of the canal—the Hon. Thos. McKay of Bytown, John Redpath of Montreal, and Robert Drummond of Kingston.

In 1827 the chief contracts were given out—Mr. Pennyfather taking the excavation for the first eight locks at the Ottawa River end, Mr. McKay the construction of these eight locks, as well as those at Hartwell's and Hogsback, Mr. Redpath the great works at Jones Falls, Messrs. Fenelon & Henderson the earth excavation and grading from the entrance locks to Dow's Swamp and thence to Hogsback, whilst Mr. Robert Drummond had the Kingston Mills locks and the extensive dykes and dam near there.

On the 26th October, 1827, Col. By, with the experience

of more than a year to guide him, as well as a personal acquaintance with the details of the work, made up for the Ordnance Department in London his own estimate of the cost of the canal. It reached the sum of £463,899 stg. This vast increase over the estimate of the commission of 1826 created an intense stir in the department, and resulted in orders being sent out to Col, By for the immediate stoppage of all work wherever practicable, and in the appointment of a commission, composed of Sir Jas. Kempt, Col. Edw. Fanshaw and Col. Lewis, to investigate the character of the work and the cause of the extraordinary expenditure. This committee, on the 28th June, 1828, reported, on the whole very favorable to Col. By, and recommended the canal to have a depth of 5 feet at the lowest water and the locks to be of a size to admit a steamer 108 feet long and 30 feet wide. On this report the size of the locks was fixed at 134 feet by 33 feet, and the work pressed on with Col. By's accustomed vigor.

After much difficulty and repeated failures at the works at Hogsback and Dow's Swamp, near Bytown, and great loss of life at some points, particularly Kingston Mills, where about 500 laborers died from malaria, necessitating the raising of the dams in order to flood the extensive swamps of the Cataraqui River, the Canal was ready for opening in August, 1831. Another delay however took place. Mr. Merrick, of Merrickville, cut off the water at that point by a dam in order to make repairs to his mills. This act raised very serious legal questions which were not settled before the winter set in. In consequence, it was not until the 29th May, 1832, that the first steamboat the "*Pumper*" with Col. By and his family on board, passed through from Ottawa to Kingston, and the Canal was formally opened to traffic.

On the 8th January, 1831, in writing to Col. Glegg, for the information of the Commander of the Forces, Col. By mentions that his estimate of the cost of the work as presented to the Imperial Commission in June, 1828, was

£693,449 stg. All of the official papers connected with the Canal do not appear to have been printed as parliamentary returns, but the last estimate published brought up the cost to nearly £800,000 stg.

As the city of Ottawa owes its inception to the construction of the Rideau Canal, it is interesting here to note that the first settler at Hull was Philemon Wright. the founder of the Wright family there, who on the 3rd January, 1806, obtained a crown patent covering lot 2 in the 3rd range including the water privileges at the Chaudiere Falls on that side of the river. The original locatee of the corresponding lot and water privilege on the Ontario side was Robert Randall, whose rights were however in 1820, bought at sheriff's sale by Lieutenant Le Breton, from whom, and from the large exposed areas here of level, Trenton limestone, the locality acquired the name of "Le Breton Flats." In 1820, Earl Dalhousie bought for the government, the Fraser property, lying between the Sparks and Besserer properties on the one side, and the Ottawa River on the other, and on instructions from him in the end of September, 1826, Col. By, laid out in town lots the upper part of this, and Dr. A. J. Christie became apparently, the first locatee of a lot upon the site. In 1827, the swamp then covering a considerable area east of the Canal entrance, was drained, divided into lots, and became known as Lower Town, to distinguish it from the part surveyed during the previous year which was called Upper Town. The name of Bytown—in honor of Col. By—was then given to the two settlements, which were separated not only by the Canal but also by what was known as Barrack Hill, now the site of the Parliament Buildings. The name Bytown, soon became thoroughly established. Reference is made to it in the Imperial Commissioner's report of the 28th June, 1828, and on the 18th July, 1829, a petition from "some of the inhabitants of Bytown" was forwarded to Sir James Kempt, complaining about the conditions on which town lots had been sold. Thus originated the present city of Ottawa.

On the Political and Economic Significance of the Small Industries; and their Encouragement by Central-Station Power Supply.

By J. T. Nicolson, B.Sc. (Edin.), McGill University.

II.

In a former number of the Record[1] the author endeavoured to present to its readers two practical solutions of the labour troubles which now agitate the commercial world. The belief was expressed in that article that these troubles proceed from the real and actual ill conditions of life of the manufacturing classes, and not from an unreasonable and insatiable desire to possess more than their proper share of the world's good things. This led to the claim being then made that either the artisan must become a partner in the profits as well as the labours of those large manufactories where he at present occupies such an unconsidered position; or that he must be helped to become an independent workman or small employer himself; so that in either case he may have an adequate reward for his skill and diligence, and may eventually look forward to a modest competence as the fruits of his toil.

The former of these plans was stated to have been tried on several occasions, and with most successful results: the obstacle to its more general adoption being only the selfishness and rapacity of our capitalists, who, either in their own persons or their successors, must inevitably pay a penalty for their political short-sightedness.

The latter method was declared to be impossible, so long as the cost of steam or other power remains as high as it is now when used in such small quantities as in the case of workmen desiring to be their own employers. If the idea of making a large number of our artizans contented because self-dependent be worthy of adoption, the first desideratum was shown to be the possibility of supplying power at such a low price as to enable them to compete with their, at

present, much too favourably situated competitors, the mill-owners. That this was the real want was emphasized by reference to the enormous advance recently made in the amount of machinery used by man, and to the certain continuance of this increase in the future.

Difficult problems must arise for solution in connection with the adoption of such schemes. The probability of their successful survival in the face of the changed relations between capital and labour, the altered conditions of demand and supply, and the effects of their action upon the national industries and international trade must be investigated. In short, their entire political and economic significance must, no doubt, be well considered in all generality before their establishment on a large scale as working systems can be acquiesced in.

With such an inexact science as political economy, however, a good experiment is worth more than an excogitation and demonstration of results which may never happen, owing to the uncertain action of human free will.

It was hence finally concluded that the whole matter of alleviation of the condition of the working classes lay largely in the hands of the engineering profession, on whom rests the *onus* of cheapening the supply of power by technical advances to be made by them in the transmission and distribution in large manufacturing centres. Not until this has been done will it be possible to make trial with any hope of commercial success of the latter system of industrial organization here proposed.

It would be useless to encourage artizans to become their own employers so long as the cost to them of their most vital need, machine-power, remains five or six times what the capitalist has to pay.

This paper is accordingly devoted to a brief account of the present conditions and the possibilities of success of one of the three systems of power supply most commonly used.

Of these three, electric, hydraulic and pneumatic, the last-named has been chosen for first discussion.

In a scheme for the transmission and distribution of

power by means of air under pressure, the chief parts are: the source of power, the prime mover, the air-compressor, the air reservoir and mains, the distributing pipes, the preheaters, and the motors.

Source of power.—This may be either a waterfall or simply coal. So long as coal retains its present position as the cheapest vehicle of energy we possess, our cataracts and rapids must continue to occupy the secondry place as cheap sources of power. This is due to the fact that the interest on the first cost of the plant necessary to intercept, as it were, the power from the falling water and to transmit it to the required locality is usually greater than the annual outlay due to capital expended on boilers and engines and the price of coal used. The cost per annum per horse-power delivered by a turbine (for the dam, head- and tail-races, penstocks, gates and wheel pit) varies from $2.00 to $25.00, according to the height of the water-fall impounded. On the other hand, the sum of $20.00 will amply cover the cost per annum of one horse-power delivered by a large steam engine. The difference between these figures, varying from $18.00 to $5.00 per horse-power, is what remains available to cover the expense of transforming the power at the water supply into a form suitable for transmission, for its subsequent conveyances, and for its retransformation into mechanical work at the point where it is required to be employed. The interest on the capital outlay and running expeuses of any such transmission system usually exceeds the balance above shown available, and allows the steam engine to win the race.

The great transmitters of energy are, indeed, our railways and steamships, which transport, at a rate vastly cheaper than by any other means, the enormous stores of mechanical energy accumulated in our coal fields; and that in any amount and to any distance, unhampered by the losses of power which inevitably accompany every transportation.

Prime-movers.—When water is the source of power the prime-mover is a turbine, which is turned by either the

pressure or the velocity, or both, of the falling water. If coal is used, steam-engines and boilers give out the necessary mechanical work. In either case the energy is ready to be taken from a rotating shaft, which, if it is to be applied so as to compress air, may not turn more than about eighty times a minute. This speed is for turbines a somewhat slow one. The slower the speed, the larger must be the turbine to develope a given power. This is a disadvantage, as it largely increases the first cost.

Air-compressor.—A machine having organs almost identical with those of a steam-engine is used to transform the energy obtained from the above-mentioned rotating-shaft into that of a potential kind possessed by compressed air. Such an air-compressor, if large, will consist of three cylinders and two intermediate vessels or receivers. These three cylinders are of different sizes. When the piston in the largest of the three moves in one direction it draws, by the ordinary principles of suction, a cylinder-full of air from the atmosphere. During the return stroke the air is compressed, by the closing of the inlet valve, into a smaller volume, and its pressure is correspondingly raised. When the pressure rises to that of the first of the two receivers, the outlet valve opens and the remainder of the stroke of the piston is devoted to delivering this air into it. The second cylinder, which is smaller, acts in precisely the same way, except that it draws air from the first receiver instead of the atmosphere, and delivers it into the second receiver at a still higher pressure. The third and smallest of the three cylinders derives its supply of air at a high pressure from the second receiver, and finally delivers it in a still more compressed state into the storage reservoirs or transmission mains at the required high pressure suitable for conveyance to a distance.

The two intermediate receivers have another and most important function to fulfil besides that of mere receptacles. In the act of compression, heat is very apt to be generated in the air; and the receivers are intended to act also as

cooling vessels where the fluid, by remaining for some time before suffering further compression and consequent heating in the next cylinder, can part with some of its heat. Thus, by the action of the inter-coolers, the pressures against which the piston in the second and third cylinders have to act, are lower than they otherwise would be with a high temperature of final delivery into the mains. Any heat which the air entering the mains may possess above the temperature of the atmosphere will obviously be lost during the long journey to the distributing pipes and motors. The less heat, consequently, that is generated during the process of compression, the more economical in power that process will be. Every means for keeping the air cool that can with advantage be used, such as jacketing the cylinders with cold water, injecting water into the cylinders as a fine spray, and in the case of compound compressors the adoption of inter-coolers, is consequently resorted to. The air finally delivered by the compressor must, if it has been subjected to spray injection, before it passes into the mains, be deprived of all particles of water suspended amongst it. This is done by passing it through reservoirs containing baffle plates, which separate out the water particles from the air by the action of the surface film on the little drops, and by gravity.

Air Mains.—The pipe for conveying the compressed air from the source of power to the locality where it is to be distributed is preferably as smooth in its interior as possible. If large enough to be a riveted structure, the heads of the rivets inside should be countersunk, so as to offer no projections to increase the resistance. The joints which connect together successive lengths of pipe, must be flexible to some extent, so as to allow of the pipe line yielding to lateral movements of the earth which surrounds it. They must at the same time be and remain so tight that the loss of air by leakage is inappreciable.

These conflicting conditions are perfectly capable of a satisfactory simultaneous fulfilment. In the mains of Paris,

which has a large pneumatic system of power distribution, the loss due to leakage was less than half a pound per square inch of the working pressure in one mile of main; and the joints which produced these good results have been found satisfactory in every other respect. The loss of power due to friction in the pipes proved also unexpectedly small, as was shown in the experiments of Professors Riedler and Gutermuth.

Satisfactory results can certainly be obtained when the distance of transmission is as great as fifteen or even twenty miles.

Distributing Pipes.—The same remarks regarding tightness and efficiency, when transmitting a supply of air under pressure, apply to the distribution pipes. And it should be further mentioned that the depth at which such pipes need be laid is much smaller than is required for water or gas mains. This is a very obvious advantage, especially in large cities.

Motors and Pre-heaters.—The pressure of the air in the distributing pipes is owing to friction and leakage, less than that at which it was delivered by the air-compressors. It ought, however, still to be higher than the greatest pressure to be used in any of the air motors of the system. The air has also lost all superfluous heat above the temperature of the atmosphere it may have possessed on its entrance into the mains.

The reader will perhaps remember that during the process of compression the air was unavoidably heated by the working pistons. He will then readily understand that during the process of expansion and abstraction of work from the compressed air in the air motors a considerable fall of temperature will take place. So much is this the case that in many air motors working in mines the exhaust pipe becomes eventually choked up by the accumulations of frozen vapour in the escaping air.

In the attempt to remedy this by heating the air before its entry into the cylinders of the motor, it has been found

that a higher degree of heating than is necessary merely to keep the exhausting air at atmopheric temperature is very conducive to economic working, as it can be effected at an insignificant cost.

The pre-heaters used in Paris for this purpose are tiny little stoves, requiring an insensible amount of fuel and almost no attention.

Notwithstanding this, the air delivered to motors, although at the same pressure, is so much increased in volume and temperature that all the losses due to leakage, friction and inefficiency of the operating machinery can be entirely wiped out at an additional expenditure almost infinitesimal, and without increasing the complexity or working difficulties of the system.

The air motors may be simply old steam engines, no alteration being necessary except the putting of them in good repair. If the motors are specially designed for use with air, instead of steam, better results will, of course, be obtained; and this is above all the case with the smallest sizes. For the larger sizes, however, a consumer who wishes to change from steam to air has only to discard his boiler, discharge his fireman, and couple his steam pipe to the compressed air main.

Turning to the commercial feasibility of a scheme for the supply of power by means of compressed air in a large industrial centre, the author has estimated that a Centrat Station Power Supply Company could, in a city like Montreal, supply to consumers, whether large or small, sufficient air to generate one horse power on their motor-brakes for $24.00 per annum; and secure at the same time 10 per cent. interest on their capital outlay. The price now paid for power by small cousumers ranges from $60.00 to $120.00 per annum, and is never less than $50.00.

Reference may now be made to many advantages, apart from the question of cost, which attend the adoption of the pneumatic system.

In the first rank we may place the elimination of 95 per cent. of the smoke which now renders manufacturing centres

so obnoxious from an æsthetic point of view, and of the dangers and responsibility attending the use of steam boilers by unskilled persons: these being done away with or removed from the more crowded parts of the city. The possibility of running air motors in the centre of the city, where a supply of water for condensing or even feed is extremely expensive, is an obvious advantage.

The extreme handiness of the working medium and its suitability for use by technically unskilled attendants may be adverted to. In this respect the air motor bears away the palm from the electric motor, the gas engine, and even the much-enduring steam engine, all of which require a certain modicum of knowledge or experience. The repair also of such a machine requires only a knowledge of perfectly well understood mechanical details.

The use of the exhaust for either refrigeration, ventilation or even heating renders the rejected air a beneficial by-product instead of a nuisance, as the exhaust from a steam engine certainly is in summer.

The suitability of compressed air for the working of lifts ought not to escape mention; a cheapening of the first cost by at least 10 per cent. and of running expenses at the rate of 75 over other systems can be easily attained.

Tram cars worked by compressed air are now in use in Nantes, Brussels, Chester and other places; they have there proved both serviceable and economical, in spite of the fact that the power they use is generated in small compressing stations. A reservoir capacity with air at perfectly safe pressures can be obtained with an ordinary sized car to do a return journey of five miles without any intermediate charging station; and the consequent removal of a dangerous overhead wire, such as is used on the electric trolly system, is not to be despised in a populous city. The difficulty of snow could be overcome by having a car devoted to clearing the tracks alone; but this will be preferably effected by having a light overhead railroad, as the ruts in the streets caused by keeping a clean tramroad in

winter are extremely unpleasant, not to say dangerous, to occupants of vehicles.

Other advantages of the adoption of a scheme for power distribution by means of air under pressure might be discussed. Enough has been said, however, to warrant the assertion that the great technical advances recently made in this matter are sufficient to place the pneumatic system in the forefront as a realizable scheme.

The practical success it has met with in Paris, where 13,000 horse power are now at work, is an instance on a large scale of the possibility of the distribution of power by means of compressed air.

THE WORLD'S GEOLOGICAL CONGRESS.

By HENRY M. AMI, M.A., D.Sc.

As an auxiliary of the World's Columbian Exposition, the World's Geological Congress was held at Chicago during the week commencing Monday, the 21st of August, 1893.

It had been thought desirable "that there should be an exposition and comparison of the progress which the various countries have made in the delineation of their geological formations," and, accordingly, the committee appointed by the Congress Auxiliary to prepare a programme for the Geological Congress submitted the following themes for discussion and consideration :

I. On geological progress.
II. On continental growth and international relations.
III. On palæontological and archæological geology.
IV. On physical, structural and petrographical geology.
V. On economic geology.
VI. Miscellaneous.

There was a fairly good representation of geologists from the United States and Canada; but very few Europeans were present, a circumstance much to be regretted. Yet these latter sent papers, which were read and formed an interesting part of the work in the sessions.

The first three days of the Congress were devoted to geological work and papers by women, during which time the following papers were presented:

Methods of Teaching Geology—Miss Mary Holmes, Ph.D., Rockford, Ill.

Physical Geology—Miss Mary K. Andrews, Belfast, Ire.

Chemical Geology—Miss Louise Foster, Boston, Mass.

Granites of Massachusetts and their Origin—Mrs. Ella F. Boyd, Hyde Park, Mass.

Artistic Geology—Mrs. S. Maxon-Cobb, Boulder, Colo.

The Geology of Ogle County—Mrs. C. M. Winston, Chicago.

The Fossils of the Upper Silurian—Mrs. Ada D. Davidson, Oberlin, Ohio.

Crinoidea and Blastoidea of the Kinderhook Group as Found in the Quarries near Marshalltown, Iowa—Jennie McGowen, A.M., M.D., Davenport, Iowa.

The Evolution of the Brachiopoda—Miss Agnes Crane, Brighton, England.

The Mastodon in Northern Ohio; Post-Glacial or Pre-Glacial—Miss Ellen Smith, Painesville, Ohio.

Palæontology—Miss Jane Donald, Carlisle, England.

Glacial Markings—Miss Thompson, Newcastle, England.

On the 24th, 25th and 26th of August the Congress met in the Art Institute of Chicago, under the presidency of Dr. A. R. C. Selwyn, Prof. J. Le Conte and Prof. James Hall, respectively.

As representatives of Canada, Dr. Selwyn, director of the Geological Survey, Dr. Bell and Dr. Ami read papers at the Congress, all of which elicited interesting discussions. Besides these the following Canadian geologists registered. Dr. G. T. Kennedy, Nova Scotia, Messrs. N. J. Giroux, H. P. Brunnell, L. M. Lambe and E. D. Ingall, of the Geological Survey Staff.

The following is a complete list of the other papers presented at the Congress, whose sessions were held in the morning in order to give the members an opportunity of visiting the fair grounds in the afternoons, special

prominence being placed on the Mining Department building.

Thursday, August 24.

The General Geology of Venezuela—Dr. Adolph Ernst, special delegate from Venezuela so the Columbian Exposition.

Pre-Cambrian Rocks of Wales—Dr. Henry Hicks, London, England.

The Classification of the Rock Formations of Canada, with special reference to the Palæozoic Era—Dr. Henry M. Ami, Geological Survey of Canada.

The Cordilleran Mesozoic Revolution—Dr. A. C. Lawson, University of California.

The Oil Shales of the Scottish Carboniferous System—Henry M. Cadell, late of the Geological Survey, Scotland.

The Pre-Palæozoic Floor in the Northwestern States—Prof. C. W. Hall, University of Minnesota.

Distribution of Pre-Cambrian Volcanic Rocks along the Eastern Border of the United States and Canada—Prof. George H. Williams, Johns Hopkins University.

They were followed by a special discusston on the question: "Are there any Natural Geological Divisions of World-wide Extent?" Introduced by Prof. J. Le Conte.

Friday, August 25.

Huronian versus Algonkian—Dr. A. R. C. Selwyn, Geological Survey of Canada.

On the Migration of Material during the Metamorphism of Rock Masses—Alfred Harker, St. John's College, Cambridge, England.

Wave like Progress of an Epeirogenic Uplift—Warren Upham, Geological Survey of Minnesota.

Zur Nereiten Frage—Dr H. B. Geinitz, Dresden.

Genetic Classification of Geology—W. J. McGee, Bureau of Ethnology.

Precious Stones and their Geological Occurrence—Dr. George F. Kunz.

The Extent and Lapse of Time Represented by Unconformities—Prof. C. R. Van Hise, U. S. Geological Survey.

The Phylogeny of the Classes of Vertebrates—Dr. O. Jaekel, Berlin, Germany.

Restoration of Clidastes (illustrated)—Prof. S. W. Williston, University of Kansas.

Special Discussion.

"What are the Principles and Criteria to be Observed in the Restoration of Ancient Geographical Outlines?"—by Dr. W. J. McGee.

Saturday, August 26.

Glacial Succession in the British Isles and Northern Europe—Dr. James Geikie, Geological Survey of Scotland.

Glacial Succession in Sweden—Hjalmar Lundbohm, Geological Survey of Sweden.

Glacial Succession in Switzerland—Dr. Albrecht Heim, Zurich.

The Succession of the Glacial Deposits of Canada—Dr. Robert Bell, Canadian Geological Survey.

Glacial Succession in the United States—Dr. T. C. Chamberlin, University of Chicago.

Pleistocene Climatic Changes—Warren Upham, Geological Survey of Minnesota.

Evidences of the Diversity of the Older Drift in Northwestern Illinois—Frank Leverett, U. S. Geological Survey.

The presence of the venerable Prof. Hall at the Congress was the signal for a hearty welcome being tendered him as he entered the hall.

In the discussion which followed the reading of Dr. Selwyn's paper entitled "Huronian versus Algonkian," Prof. Van Hise stated that the term Algonkian was only a provisional one. Prof. T. C. Chamberlin advocated the use of the term Proterozoic in the place of Algonkian, inasmuch as the termination of the letters is not uniform with such terms as Palæozoic, Mesozoic, etc., to which the term Algonkian is alleged to be comparable.

Following the first special discussion on "Natural Divisions in Geology of World-wide Extent," Prof. H. S. Williams pointed out the *rôle* which the "cuboides zone" played in this respect, whilst Dr. Ami pointed out the world-wide extent of certain graptolitic zones and the reasons which probably led thereto. Dr. Le Conte considered at length the present Human Period.

OBITUARY NOTICE.

Dr. John Rae, F.R.S., F.R.G.S.

In the death of Dr. John Rae, Canada and Natural Science have lost a warm friend, and the world loses one of the most active and energetic of geographical explorers. Dr. Rae was born at the Hall of Clestrain, Orkney Islands, on September 30th, 1813, and died at No. 4 Addison Gardens, London, on July 22nd, 1893, having nearly attained the age of 80 years. The following notice is from the *Canadian Gazette:*

At the beginning of April last Dr. Rae was seized with a violent attack of influenza followed by congestion of the lungs, and although at times during the interval he seemed to be getting better, he never permanently recovered. Three weeks before his death his conditton seemed so greatly improved that arrangements were made for him to leave his bedroom for the first time since April, and Mrs. Rae had even gone so far as to contemplate his removal to the seaside. On July 13th, however, he had a sudden and severe relapse, though hopes were still entertained of his recovery when he passed away last Saturday. Up to the very last he was perfectly conscious, his robust physique seeming to defy even the ravages of time, and on the morning of his death he read through the whole account of the Bisley meeting, taking an especial interest in the doings of the Canadian team. The remains are to be conveyed to Kirkwall, Orkney, and will be interred in the cathedral burial ground by the side of those of his old friend and companion, Dr. Bakie, the African traveller.

Dr. Rae was popularly known as the discoverer of Sir John Franklin's remains. He was born at the Hall of Clestrain, Orkney Islands, on September 30th, nearly eighty years ago. He studied medicine at the University of Edinburgh, and in 1833 was appointed surgeon to the Hudson's Bay Company's vessel which annually visited Moose Factory on Hudson's Bay. In June, 1846, he set out on his first voyage of exploration on behalf of the same company, and so success-

fully was this accomplished that he was offered and accepted, in 1848, the place of second in command of the expedition under Sir John Richardson to search for Franklin. This expedition was unsuccessful, but in the spring of 1849 Dr. Rae was appointed to command another search party to the Arctic coast. In order to utilize the time before navigation opened, he, accompanied by two men, made a journey along the shores of Wollaston Land, traversing over 1,100 miles, he himself dragging his sleigh. The average day's journey was about twenty-five miles, and the whole shore was minutely examined, including Victoria Strait, in which, as it afterwards appeared, Franklin's ships had been abandoned. Continuing the exploration, he and his party, with the aid of snowshoes, marched continuously, at the rate of twenty-seven miles a day, to Fort Garry, now the city of Winnipeg. In about eight months they travelled 5,380 miles, 700 miles of which was newly discovered territory.

For his services in this connection, and for the survey of 1847, Dr. Rae was awarded the Founder's Gold Medal of the Royal Geographical Society. There being still a considerable portion of the Arctic coast unexplored, Dr. Rae in 1853 took command of an expedition organized by the Hudson's Bay Company to trace the west coast of Boothia, and, from information obtained from the Esquimaux, he succeeded then in placing beyond all doubt the fact that Franklin and his men had perished from exposure and hunger. On this occasion he purchased from the natives a number of relics of the ill-fated party. Returning to London in the latter part of 1855, he found that he was entitled to £10,000, which the Government had offered for the first news of Franklin, a fact unknown to him while conducting the expeditions. In 1860 Dr. Rae took the land part of a survey of a contemplated telegraph line to America *via* the Faroe Islands and Iceland. Greenland was next visited, and in 1864 he took a leading part in a telegraph survey from Winnipeg across the prairie and through the Rocky Mountains. Subsequently some hundreds of miles of the most dangerous parts of Fraser River were run down in small dugout canoes without a guide—a most perilous undertaking, but successiully accomplished.

But though Dr. Rae travelled much, and saw much of unknown parts, covering in his time some 1,500, if not 1,800 miles of previously unexplored ground, he wrote little. His reports to the Royal Geographical Society are on that account all the more valued, as are his short papers on the Esquimaux and other subjects; and in 1850 he published a "Narrative of an Expedition to the Shores of the Arctic Sea in 1846 and 1847." He was a frequent and welcome attendant at the meetings of the Royal Geographical Society, where his record of travel, his genial manner, and graphic powers of description were often in request. During the latter years of his life he maintained a keen interest in colonial matters. He was an active member of the Royal Colonial Institute, and with Sir Henry Tyler he represented Ontario on the executive of the Imperial Institute. As one of the

first directors of the Canada North-West Land Company, and as director of other commercial enterprises in Manitoba and British Columbia, he evinced his belief in the future of the new West, and that belief he was never slow to attest in his communications to the columns of this and other journals.

Dr. Rae leaves no children. Mrs. Rae, to whom he was married in 1860, nursed her husband with devoted care during his long illness. her watch being shared py her sister, Miss Skeffinton Thompson, and they will have the sympathy of many friends in Canada and this country and of all who came into association with the deceased in his many activities,

The following, relating more especially to the scientfic value of his labours, is from *Nature:*

In 1845 his true career as an Arctic explorer began in his undertaking the leadership of a small expedition to explore a considerable extent of the coast line ef the Arctic Sea. In June, 1846, he set out on this expedition from York Factory, coasted along the west side of Hudson Bay, and wintered on the shore of Repulse Bay. Early in 1847 he made an extensive land journey to the north and west, with the result that 700 miles of new coast were surveyed, almost filling the gap between Ross's work in Boothia and Parry's at Fury and Hecla Strait. In 1859 Dr. Rae published an account of this expedition in the form of a book of 250 pages. This was, curiously enough, his only permanent contribution to geographical literature, his subsequent journeys being recorded merely in formal reports published in the *Journal* of the Royal Geographical Society. After this journey Rae came to London, but was almost immediately induced to join the first land expedition sent to seek for Sir John Franklln, under the leadership of Sir John Richardson. The expedition was unsuccessful as to its primary purpose of finding traces of Franklin, but it effected a satisfactory survey of the whole coast between the Mackenzie and Coppermine rivers. In 1851 Rae received the command of another boat expedition for the Hudson Bay Company, in the course of which he thoroughly explored and mapped the south coast of Wollaston Land and Victoria Land, still searching vainly for traces of Franklin's party. On his return from this arduous undertaking, which he conducted throughout with conspicuous daring and sagacity, he had to travel on snowshoes, and himself dragging a sledge, across the whole breadth of Canada from the Arctic Sea, through Fort Garry (now Winnipeg) until he reached United States territory. His total walking on this expedition was 5,000 miles, of which 700 miles were traversed for the first time. On returning to England in 1852 the gold medal of the Royal Geographical Society was presented to him by Sir Roderick Murchison, in a speech the cordial terms of which showed how fully Dr. Rae's genius for Arctic travel with the minimum of equipment and an infinitesimal expense was appreciated by the highest authorities. In no wise

deterred by the hardships of his earlier campaigns, Rae left England early in 1853 to continue his work in the far north; the Hudson Bay Company equipping an expedition on condition that he would lead it personally. He completed the survey of King William's Land on this occasion, proving it to be an island; 1,100 miles of sledging were accompiished in the process, of which 400 miles were new discovery. But the really important result of this expedition was Dr. Rae's meeting with the first evidence of Sir John's Franklin's fate, from the story of a party of wandering Eskimo. The tribe encountered were in possession of many personal relics of members of that ill-fated expedition, which Rae secured and brought home. When he returned to England with the news so long searched for and so anxiously awaited, the Admiralty, which had spent large sums in fitting out successive expeditions, concluded that the fate of Franklin was decided beyond a doubt, and accordingly awarded to Dr. Rae the sum of £10,000 offered by Government to the first who brought back decisive information. The justice of this award was at the time strongly objected to by Lady Franklin, and, although no further action was taken by Government, she continued to organize private expeditions, which, while proving in effect the correctness of Dr. Rae's information from the Eskimo, served in no small degree to advance the geographical survey of the polar area.

In all his expeditions Dr. Rae made collections of characteristic plants and animals as well as physical and meteorological observations. The material, described by other workers, went to swell the sum of our knowledge of the general conditions of climate and life in the Arctic basin.

In 1860 and subsequent years Dr. Rae made a series of intaresting journeys in Iceland, Greenland and North America with the object of exploring and arranging routes for telegraph lines. His later years were spent in this country, where he made himself conspicuous by his zeal in forwarding the volunteer movement, being himseif an excellent shot. The feeling which grew upon him to a painful extent as he became older, that his brilliant explorations were not adequately recognized and acknowledged on the Admiralty charts, unfortunately somewhat embittered his last years. But to the end he took the keenest interest in Arctic travel, and was ever ready to take part in discussions bearing on the region in which he lived so long and suffered so much. He was a regular attendant at meetings of the Royal Geographical Society and Colonial Institute, and for many years attended the gatherings of the British Association.

NOTICES OF BOOKS AND PAPERS.

"THE FOSSIL INSECTS OF NORTH AMERICA, VOLS. I AND II, BY PROF. S. H. SCUDDER; MACMILLAN & CO., NEW YORK, 1890," WITH SPECIAL REFERENCE TO CANADIAN SPECIMENS.

Having had occasion to look into Prof. Scudder's recent monograph of "The Fossil Insects of North America" it has occurred to me that for students of Canadian geology, it might not be uninteresting to write a few notes on that part of this admirable work which affects them more particularly, and give a condensed list of the forms therein described with a view of ascertaining what has been done to date.

VOLUME I.

The first paper or portion of this volume which refers to Canadian insects, is one entitled: "On the Carboniferous Myriapods preserved in the Sigillarian stumps of Nova Scotia," with supplementary page and cut, pp. 21—31.

Full descriptions of the following species are therein given :—

MYRIAPODA.

1. Xylobius sigillariæ, Dawson.
2. " similis, Scudder.
3. " fractus, Scudder.
4. " Dawsoni, Scudder.
5. Archiulus xylobioides, Scudder.

Then comes the chapter on "The Devonian Insects of New Brunswick," with a note by Sir William Dawson, pp. 154-194, and elaborate descriptions of six species from the Devonian rocks of New Brunswick, as follows:

1. Platephemera antiqua, Scudder.
2. Gerephemera simplex, Scudder.
3. Dyscritus vetustus, Scudder.
4. Lithentomum Harttii, Scudder.
5. Xenoneura antiquorum, Scudder.
6. Homothetus fossilis, Scudder.

These belong to the family of the Ephemeridæ, whose structure and affinities are discussed at great length, whilst a summary of facts regarding fossil insects is given, which may well be presented here in a condensed form :—

Prof. Scudder's conclusions regarding early fossil insects are these :—

(1.) "That the general type of wing structure has remained unaltered from the earliest times.

(2.) These earliest insects were Hexapoda.

(3.) They were all lower Heterometabola.

(4.) Nearly all are synthetic types of a comparatively narrow range.

(5.) Nearly all bear marks of affinity to the Carboniferous palæo-ictyoptera.

(6.) On the other hand, they are often of more and not less com-licated structure than most palæodictoptera.

(7.) With one exception, they bear little special relation to Carboniferous forms, having a distinct facies of their own.

(8.) The Devonain insects were of great size, had membranous wings and were probably aquatic in early life.

(9.) Some of the Devonian insects are evidently precursors of existing forms while others seem to have left no trace.

(10.) They show a remarkable variety of structure indicating an abundance of insect life at that epoch.

(11.) The Devonian insects also differ remarkably from all other known types, ancient or modern; and some of them appear to be even more complicated than their nearest living allies.

(12.) We appear, therefore, to be no nearer the beginning of things in the Devonian epoch, than in the carboniferous so far as either greater unity or simplicity of structure is concerned.

(13.) Finally, where there are some forms which tosome degree bear out the general derivative hypothesis of structural development, there are quite as many which are altogether unexpected, and cannot be explained by that theory, without involving suppositions for which no facts can at present be adduced."

Sir William Dawson's note is entitled : "Note on the Geological relations of the Fossil Insects from the Devonian of New Brunswick," in which a section of the rocks taken at the "Fern ledges" is presented and no less than eight "plant-beds" are enumerated and the various forms found in each recorded—the total thickness of the beds embraced in this section "being" 440 feet, 11 inches.

Fossil Cockroaches.

Then comes "The species of Mylacris, a Carboniferous genus of Cockroaches" with reference to a form described from the coal measure of Sydney, Cape Breton under the following designation:—

1. Mylacris Bretonense, Scudder. The other palæozoic cockroaches known from Canadian rocks were described by the same author in a preceding chapter, viz : "Palæozoic cockroaches, a complete revision of the species of both worlds, with an essay toward their classification." These are described in the monograph, pp. 43-154, and are from the Acadian coal field. They include

Sydney, Cape Breton,

1. Mylacris Bretonense, Scudder.
2. " Heeri, Scudder.
3. Petroblattina sepulta, Scudder.

Pictou. Nova Scotia,

4. Archimylacris Acadicum, Scudder, from the "shale overlying roof of main coal seam," East River, Pictou.

In another chapter on "The earliest winged Insects of America," Prof. Scudder gives to the scientific public the result of his "re-examination of the Devonian Insects of New Brunswick, in the light of criticisms and of new studies on other palæozoic types," pp. 275—282.

Gerephemera is here referred to the order *Protophasmida* and Homothetus is taken from the order Odonata, whilst the relations of the Devonian forms to Carboniferous more akin than at first supposed are given. The criticisms made by Dr. Hagen on Prof. Scudder's works and writings are here treated in the kindly spirit of searching for light and finding it.

VOLUME II.

Volume II contains notes on and descriptions of the Tertiary insects of North America, and it is of special interest to students of Canadian Geology and Palæontology, inasmuch as it throws much light upon the structure and affinities of fossil specimens from two principal horizons in the stratigraphical sequence, viz.: (1) the Miocene rocks of British Columbia, and (2) the Interglacial beds of Scarboro, in the Province of Ontario.

In this volume no less than sixty-seven Canadian species of insects are described in full and figured. They belong to the orders Hemiptera, Coleoptera, Diptera and Hymenoptera, which are here appended in tabular form, so as to make them easy for reference.

Notes on the localities where these fossil insects are found are here inserted from the large monographs, and will no doubt prove interesting. These writings of Prof. Scudder will shortly be supplemented by description and figures of fossil insects from British Columbia, and from the Leda clay of Green's Creek, near Ottawa.

"The discovery of the different localities for fossil insects in British Columbia by the Geological Survey of Canada, has been due entirely to the investigations of Dr. George M. Dawson. On the left bank of the Fraser River, at the town of Quesnel, he discovered a series of clays, sands and gravels, their upturned edges covered by the valley deposits, in one of which series (a stratum of fire clay eight or nine inches thick) insects and plants were found, the beds being exposed on the river bank at a low stage of the water. Nearly twenty species of plants were met with, mostly of apetalous families, in the neighborhood of the Cupuliferæ, such as the beech, walnut, oak, birch and poplar, and a considerable number of insects. Such of these as are included in the present report consist of twenty-five species, nearly all Hymenoptera and Diptera, and especially the latter, and, what is very unusual, only a single beetle. Sir William Dawson, who determined the plants, regarded them as to a gэrat

extent identical with those from the Miocene of Alaska, but adds: "Whether the age of these beds is Miocene, or somewhat older, may, however admit of doubt." Apart from an uncharacteristic egg cocoon of a spider, none of the insect remains can be regarded as identical with any found elsewhere.

The other localities at which remains of insects have been found, though in smaller numbers, lie at no great distance apart to the south of Quesnel, and south of the Canadian Pacific Railway, near our own border. One of these localities is upon the Nicola River, two miles above its junction with the Coldwater, at the base of a series of beds containing coal. Another is on the north fork of the Similkameen River, three miles from its mouth; the beds here, on the bank of the river, "include a layer of lignite about a foot thick, which rests on black, rather earthy, carbonaceous clays, and is overlain by fifteen feet or more of very thinly bedded, almost paper like, yellow gray siliceous shales," which contain plants and insects. The third is on Nine Mile Creek, flowing into Whipsaw Creek, a tributary of the Similkameen, where a small section of hard, laminated clays occurs with layers of softer arenaceous clays: *Seven* species were obtained from the first named locality, *five* from second and *four* from the third. The Nicola locality is remarkable for yielding only Coleoptera and one of Hemiptera; while the Similkameen locality like Quesnel, affords us Hymenoptera, Diptera and Hemiptera—three species of the last—but no Coleoptera. There can be no doubt, Dr. Dawson informed me, "that the specimens from the North Similkameen and Nine Mile Creek represent deposits in different portions of a single lake. A silicifying spring probably thermal, must, however have entered the lake near the first named place, as evidenced by the character of some of the beds, in which fragments of plants, with a few fresh water shells, have been preserved." The insects of each locality are specifically distinct from those of any of the others. As to their age, Dr. Dawson, the only geologist who has studied them, remarks that we shall "probably err little in continuing to call the Tertiary deposits of the interior as a whole Miocene, and in corelating them with the beds attributed to the same period to the southward, in the basin lying east of the Sierra Nevada."

FOSSIL INSECTS FROM ONTARIO.

"In the vicinity of Toronto and along the shore of Lake Ontario, Mr. George J. Hinde has discovered vegetable and animal remains in thin seams in clay beds which he regards as interglacial, lying as they do upon a morainic till of a special character and overlain by till of a another and quite distinct kind. His account of the locality and the reasons for his conclusions have been given by him in full.[1]

[1] Canadian Journal, New Series, vol. xv, 1887, pp 338-413.

"Among the material found by him was a considerable number of the elytra and other parts of beetles, an assemblage indeed larger than had ever been found in such a deposit in any part of the world. and they are mostly in excellent condition. Twenty-nine species have been obtained, some of them in considerable numbers. Five families and fifteen genera are represented; they are largely Carabidæ, there being six or seven species each of Platynus and Pterostichus and species also of Patrobus, Bembidium, Loricera and Elaphrus. The next family of importance is the Staphylinidæ, of which there are five genera, Geodromicus, Arpedium, Bledius, Oxyporus, and Lathrobium, each with a single species. The Hydrophilidæ are represented by Hydrochus and Helophorus each with one species; and the Chrysomelidæ by two species of Donacia. Finally, a species of Scolytidæ must have made certain borings under the bark of juniper. Most of these are described and figured in the present volume. Looking at them as a whole, and noting the distribution of the species to which they seem to be most nearly related, they are plainly indigenous to the soil, but would perhaps be thought to have come from a somewhat more northern locality than that in which they are found; not one of them can be referred to existing species, but the nearest allies of not a few of them are to be sought in the Lake Superior and Hudson Bay region, while the larger part are inhabitants of Canada and the Northern United States, or in the general district in which the deposit occurs. In no single instance were any special affinities found with any characteristically southern forms, though several are most nearly allied to species found there as well as in the north. A few seem to be most nearly related to Pacific forms, such as the Elaphrus and one each of the species of Platynus and Pterostichus. On the whole, the fauna has a boreal aspect, thought by no means so decidedly boreal as one would anticipate under the circumstances."

Table giving list of Fossil Insects from Cànada, described by Prof. S. H. Scudder, in his work, "The Fossil Insects of North America," 1890:

Name.	Locality.	Formation.	Collector, etc.
HEMIPTERA.			
HOMOPTERA.			
1. Geranchon petrorum, Scudd.	Quesnel, B. C......	Miocene.	G. M. Dawson.
2. Sbenaphis Quesneli, Scudd	"	" ..	"
3. Planophlebia gigantea, Scudd	Similkameen Riv., B. C..	" ..	"
4. Cœlidia Columbiana, Scudd..	Similkameen Riv., B. C.............	" ..	"
5. Cercopis Selwyni, Scudd.....	Nine Mile Creek, B. C	" ..	"
HETEROPTERA.			
6. Telmatrechus stali, Scudd...	N. F. Similkameen R., B. C....	Miocene...	G. M. Dawson.
7. Telcoschistus antiquus, Scudd	Quesnel, B. C.....	"	"

Name.	Locality.	Formation.	Collector, etc.
COLEOPTERA.			
Scolytidæ.			
8. Hylastes ? squalideus, Scudd.	Scarboro, Ont......	Interglaci'l	G. J. Hinde.
Tenebrionidæ.			
9. Tenebrio primigenius ? Scudd	Nine Mile Creek, B. C............	Miocene...	G. M. Dawson.
Chrysomelidæ.			
10. Galerucella picea, Scudd.....	Nine Mile Creek, B. C	Miocene ..	G. M. Dawson.
11. Donacia stiria, Scudd	Scarboro, Ont......	Interglaci'l	G. J. Hinde.
12. Donacia pompatica, Scudd.	"	"	"
Scarabæidæ.			
13. Trox oustaleti, Scudd........	Nine Mile Creek, B. C............	Miocene...	G. M. Dawson.
Buprestidæ.			
14. Buprestis tertiaria, Scudd....	Nicola R., B. C....	Miocene...	G. M. Dawson.
15. Buprestis saxigena, Scudd..	"	" ..	"
16. Buprestis sepulta, Scudd....	"	" ..	"
Elateridæ.			
17. Cryptohypyus ? terrestris, Scudd..	Nicola R., B. C ...	Miocene...	G. M. Dawson.
18. Cryptophynus ? planatus, Le Conte	"	" ..	"
19. Elateridæ ? sp..............	"	" ..	"
Nitidulidæ.			
20. Prometopia depilis, Scudd.	Quesnel, B. C.?....	Miocene...	G. M. Dawson.
Staphylinidæ.			
21. Bledius glaciatus, Scudd.....	Scarboro, Ont......	Interglaci'l	G. J. Hinde.
22. Oxyporus stiriacus, Scudd...	"	"	"
23. Lathrobium interglaciale, Scudd..	"	"	"
Hydrophilidæ.			
24. Cercyon ? terrigena, Scudd..	Nicola R., B. C....	Miocene...	G. M. Dawson.
25. Hydrochus amictus, Scudd..	Scarboro, Ont	Interglaci'l	G. J. Hinde.
26. Helophorus rigescens, Scudd.	"	"	"
Carabidæ.			
27. Platynus casus, Scudd.......	Scarboro, Ont.........	Interglaci'l	G. J. Hinde.
28. Platynus Hindei, Scudd.	"	"	"
29. Platynus Halli, Scudd........	"	"	"
30. Platynus dissipatus, Scudd.	"	"	"
31. Platynus desuctus, Scudd....	"	"	"
32. Platynus Harttii, Scudd*....	"	"	"
33. Pterostichus abrogatus, Scudd	"	"	"
34. Pterostichus dormitans, Scudd	"	"	"
35. Pterostichus destitutus, Scudd..	"	"	"
36. Pterostichus fractus, Scudd..	"	"	"
37. Pterostichus destructus, Scudd	"	"	"
38. Pterostichus gelidus, Scudd..	"	"	"
39. Patrobus gelatus, Scudd.....	"	"	"

Name.	Locality.	Formation.	Collector, etc.
40. Bembidium glaciatum, Scudd	"	"	"
41. Bembidium fragmentum, Scudd ..	"	"	"
42. Nebria paleomelas, Scudd...	Nicola R., B.C....	Miocene ...	G. M. Dawson.
43. Loricera ? glacialis, Scudd ..	Scarboro, Ont......	Intergraci'l	G. J. Hinde.
44. Loricera ? lutosa, Scudd.....	"	"	"
45. Elaphrus irregularis, Scudd	"	"	"
DIPTERA.			
Lonchæidæ.			
46. Lonchæa senescens, Scudd..	Quesnel, B. C......	Miocene ...	G. M. Dawson.
47. Palloptera morticina, Scudd.	"	" ..	"
Ortalidæ.			
48. Lithortalis picta, Scudd.....	Quesnel, B. C......	Miocene ...	G. M. Dawson.
Sciomyzidæ.			
49. Sciomyza revelata, Scudd ...	Quesnel, B. C.....	Miocene ...	G. M. Dawson.
Helomyzidæ.			
50. Heteromyza senilis, Scudd. .	Quesnel, B. C......	Miocene ...	G. M. Dawson.
Anthomyidæ.			
51. Anthomyia inanimata, Scudd	Quesnel, B. C......	Miocene ...	G. M. Dawson.
52. Anthomyia Burgessi, Scudd..	"	" ..	"
Asilidæ.			
53. Asilidæ, sp............	N. F. Similkameen R., B. C..........	Miocene ... " ..	G. M. Dawson. "
Bibionidæ.			
54. Plecia Similkamena, Scudd.	N. F. Similkameen R., B. C	Miocene ... "	G. M. Dawson. "
Mycetophilidæ.			
55. Sciara deperdita, Scudd.....	Quesnel, B. C	Miocene ...	G. M. Dawson.
56. Trichonta Dawsoni, Scudd...	"	" ..	"
57. Brachypeza abita, Scudd....	"	" ..	"
58. Brachypeza procera, Scudd..	"	" ..	"
59. Boletina sepulta, Scudd......	"	" ..	"
HYMENOPTERA.			
Braconidæ.			
60. Calyptites antediluvianum, Scudd	Quesnel, B. C......	Miocene .	G. M. Dawson.
61. Bracon, sp..................	"	" ..	"
Ichneumonidæ.			
62. Pimpla saxea, Scudd.	Quesnel, B. C......	Miocene . .	G. M. Dawson.
63. Pimpla senecta, Scudd.	"	" ..	"
64. Pimpla decissa, Scudd.	"	" ..	"
Myrmicidæ.			
65. Aphænogaster longæva, Scudd	Quesnel, B. C	Miocene...	G. M. Dawson.
Formicidæ			
66. Hypoclinea obliterata, Scudd	Quesnel, B. C......	Miocene ...	G. M. Dawsen.
67. Formica arcana, Scudd.	"	"	"

Ottawa, 1893. H. M. AMI.

GUIDE TO THE STUDY OF COMMON PLANTS; AN INTRODUCTION TO BOTANY; BY VOLNEY M. SPAULDING, BOSTON. D. C. HEATH & Co., 1893. 8vo., pp. 246.

When all the attendant conditions are fully considered, the ques tion as to how modern botany may be taught in the best way, is one which does not admit of ready solution in such a manner as to meet the requirements of even the majority of cases, yet there seems to be a fairly general agreement upon one point, and that is laboratory work—a living, practical acquaintance with the object to be studied—must in the future more completly replace the old text book methods.

The little book before us has methods from a recognition of these facts, and an attempt on the part of the author to outline what, to him, appears to be a desirable method of proceedure for students who are pursuing a high school course, or a course preparatory to the university or college.

A chapter of advice to the student contains many hints to the student, which are both opportune and valuable, while upon the teacher is impressed the idea that for the proper study of modern botany, the subject must be pursued from a practical point of view and with plenty of simple laboratory appliances. And here the author gives the real way to the discipline of students, whom he shows that to get a pupil thoroughly interested in an important line of work, where hands, eyes and all the faculties are fully engaged, is to secure a discipline that can be attained in no other way--a result which alone more than compensates for the expense of equipment.

The subject matter of the book deals with the plant from the standpoint of its life history—the idea of development being the leading one. The absence of illustrations is to be regretted, but notwithstanding this, it is likely to prove a useful manual in the hands of a competent teacher. If it accomplishes no other object than to give an impetus to the establishment of laboratories for elementary biological work in our various schools, it will have done well. The fact that it was written in response to inquiries from teachers preparing pupils for university examinations is significant.

D. P. P.

BOTANICAL LABORATORY,
McGill University, Oct. 1893.

A READER IN BOTANY. PART II. FLOWER AND FRUIT. SELECTED AND ADAPTED FROM WELL KNOWN AUTHORS BY JANE H. NEWELL, BOSTON. GIUN & Co., 1893. 8vo., pp. 179. ILL.

The structure of the flower and its many remarkable adaptations to the visitation of insects, and the purposes of cross fertilization, is a subject that has always been invested with special interest for

the amateur as well as for the professional botanist, and nowhere has the subject been presented in a more attractive form, than in the charming little volume from the pen of Miss Newell, who, in a well arranged summary, gives some of the more important results reached by well known investigators. The book lays no claim to originality, yet it is evident from the context, that the authoress has herself been a close observer of many of the phenomena she deals with, and therefore she speaks of things of which she has personal knowledge.

The excellence of the illustrations adds much to the attractive manner in which the facts are presented. For those who have not the time or opportunity to gain a more extensive acquaintance with the subject, this little book will prove a most useful and reliable guide to some of the most remarkable of Nature's processes.

D. P. P.

BOTANICAL LABORATORY,
McGill University, Oct. 1893.

INDEX.

AB

Meteorological Obser

JULY, 1893.

187 feet. C. H. McLEOD, Superintendent.

DAY.	THERMOMETER Mean.	Max.	Min
1	74.47	87.1	63
SUNDAY.. 2	.....	85.5	64
3	68.72	77.5	6
4	67.23	76.8	6
5	64.93	75.2	[illegible]
6	68.42	79.3	[illegible]
7	71.52	81.0	[illegible]
8	71.57	85.2	[illegible]
SUNDAY........ 9	.....	69.8	[illegible]
10	63.68	72.5	[illegible]
11	67.20	77.0	[illegible]
12	60.00	76.5	[illegible]
13	64.73	75.1	[illegible]
14	69.23	79.0	[illegible]
15	71.73	80.0	[illegible]
SUNDAY........16	.....	82.5	[illegible]
17	67.95	79.4	[illegible]
18	68.03	77.8	[illegible]
19	66.10	75.	[illegible]
20	68.89	77.	[illegible]
21	73.83	85.	[illegible]
22	66.85	78	[illegible]
SUNDAY........23	.....	67	[illegible]
24	61.12	7	[illegible]
25	59.97	6	[illegible]
26	68.35	[illegible]	[illegible]
27	62.77	[illegible]	[illegible]
28	67.67	[illegible]	[illegible]
29	66.43	[illegible]	[illegible]
SUNDAY........30	.....	[illegible]	[illegible]
31	72.47	[illegible]	[illegible]
....Means	67.69	[illegible]	[illegible]
19 Years means for and including this month	68.83	[illegible]	[illegible]

Sky Clouded in Tenths Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
[illegible]	10	0	07	....	....	....	1
....	....	....	83	....	....	....	2 ....SUNDAY
[illegible]	10	2	11	0.26	....	0.26	3
[illegible]	10	4	50	0.23	....	0.23	4
[illegible]	10	5	00	0.24	....	0.24	5
[illegible]	8	0	97	....	....	....	6
[illegible]	5	0	07	....	....	....	7
[illegible]	10	0	16	0.91	....	0.91	8
....	....	....	67	....	....	....	9 ....SUNDAY
[illegible]	10	3	67	....	....	....	10
[illegible]	10	0	85	....	....	....	11
[illegible]	10	0	98	....	....	....	12
[illegible]	10	0	62	0.04	....	0.04	13
[illegible]	5	0	91	....	....	....	14
[illegible]	10	0	07	0.18	....	0.18	15
....	....	....	86	....	....	....	16 ....SUNDAY
[illegible]	10	0	56	0.17	....	0.17	17
[illegible]	10	0	54	....	....	....	18
[illegible]	9	0	77	0.02	....	0.02	19
[illegible]	[illegible]	0	95	....	....	....	20
4.7	9	0	76	....	....	....	21
[illegible]	10	4	30	0.25	....	0.25	22
....	....	....	34	0.18	....	0.18	23 ....SUNDAY
[illegible]	10	0	35	....	....	....	24
8.3	10	3	04	0.19	....	0.19	25
5.0	10	4	55	1.82	....	1.82	26
[illegible]	10	0	79	0.04	....	0.04	27
[illegible]	10	0	58	Inap	....	Inap	28
[illegible]	10	4	28	0.05	....	0.05	29
....	....	....	96	....	....	....	30 ....SUNDAY
7.8	10	0	60	0.01	....	0.01	31
6.07	..	..	58	4.59	....	4.59	Sums
5.5	..	..	59.3	4.15	....	[illegible]	19 Years means for and including this month.

Direction........	N.
Miles....	54
Duration in hrs..	6
Mean velocity...	[illegible]

Greatest mileage i
Greatest velocity
the 21st.
Resultant mileag
Resultant directi

...sea-level and ...mercury. ...ng 100.

...he 1st; and ...24th, giving a ...es. Warmest ...e 25th. High-est barometer reading was [illegible] on the [illegible]; lowest barometer was [illegible] on the [illegible], giving a range of [illegible] inches. Maximum relative humidity was [illegible] on the [illegible]. Minimum relative humidity was [illegible] on the [illegible].

Rain fell on [illegible] days.

Auroras were observed on [illegible] nights.

Thunderstorms on [illegible] days.

UST, 1893.

el. 187 feet. C. H. McLEOD, *Superintendent.*

Sky Clouded in Tenths: Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
7.5	10	6	.78	0.03	....	0.03	1
4.5	9	0	.89	....	....	....	2
3.5	7	0	96	....	....	....	3
0.8	5	0	93	....	....	....	4
3.3	10	0	.87	0.06	....	0.06	5
....	....	..	02	0.07	....	0.07	6 .... SUNDAY
6.8	10	0	.25	0.29	....	0.29	7
1.0	5	0	.91	...	....	....	8
.5	3	0	.93	....	....	....	9
.0	0	0	.94	....	....	....	10
8	3	0	.86	....	....	....	11
8 0	10	0	.00	0.02	....	0.02	12
....	....	.	.98	....	....	....	13 .... SUNDAY
2.7	7	0	.95	....	....	....	14
7 3	10	0	.60	....	....	...	15
7 8	10	4	.53	....	....	....	16
9 8	10	9	.15	0.02	....	0.02	17
9.8	10	9	.05	0 05	....	0.05	18
9.7	10	8	.00	0.09	...	0.09	19
....	. .	..	.29	....	....	....	20 ....SUNDAY
10.0	10	10	.00	0.71	....	0 71	21
3.3	10	0	.76	0 05	....	0 05	22
1 5	3	0	.89	....	....		23
9.3	10	6	.00	2.20	....	2 20	24
4.8	10	0	.49	0.02	...	0 02	25
2.2	6	0	79	....	....	....	26
....	...	.	.44	Inap	....	Inap	27 ....SUNDAY
7.8	10	0	.43	0.40	....	0.40	28
10.0	10	10	.00	3 36	....	3.36	29
2 7	3	0	.81	....	....	....	30
4 0	7	0	.83	....	.	....	31
5.16	..	..	559	7.37	....	7 37	Sums
5 4	..	..	551	3.52	....	35 2	19 Years means for and including this month.

sea-level and

ercury.

ng 100.

e 11th ; and 30th, giving a s. Warmest e 30th. Highthe 14th : low-22nd, giving a

range of 1.045 inches. Maximum relative humidity was 99 on the 21st. and 29th. Minimum relative humidity was 37 on the 13th.

Rain fell on 15 days.

Auroras were observed on 4 nights.

Lunar halo one the 23rd.

Thunderstorms on 3 days. Lightning without thunder on 4 nights.

BER, 1893.

, 187 feet. C. H. McLEOD, Superintendent.

Y CLOUDED TENTHS	Max.	Min.	Per cent of possible sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY
[illegible]	[illegible]	0	[illegible]	....	....	....	1
3	10	0	54	0.19	....	0.19	2
..	....	..	[illegible]	[illegible]	....	[illegible]	3 .... SUNDAY
5	2	0	[illegible]	....	....	....	4
0	[illegible]	0	[illegible]	0.06	....	0.06	5
3	[illegible]	6	[illegible]	....	....	....	6
3	10	6	[illegible]	0.41	....	0.41	7
7	6	0	[illegible]	....	....	....	8
7	8	0	[illegible]	...	....	....	9
..	....		64	....	....	....	10 .... SUNDAY
0	0	0	[illegible]	....	....	....	11
3	0	0	85	....	....	....	12
2	8	0	[illegible]	....	....	....	13
3	10	7	00	....	....	....	14
0	10	6	19	0.02	....	0.02	15
0	10	0	03	0.42	....	0.42	16
..	....	.	00	0.43	....	0.43	17 .... SUNDAY
2	10	0	57	0.21	....	0.21	18
0	10	10	00	....	....	...	19
8	10	0	76	0.09	....	0.09	20
7	10	0	83	....	....		21
0	10	4	00	0.11	....	0.11	22
3	10	0	04	Inap	....	Inap	23
..	...	..	90	....	....	....	24 .... SUNDAY
7	10	0	00	0.44	....	0.41	25
7	8	0	84	....	....	....	26
7	10	0	54	...	....	...	27
0	10	0	56	....	....	....	28
0	10	4	31	Inap	....	Inap	29
5	3	0	86	....	....	....	30
7	..	..	[illegible]49.0	2.40	....	2.40	Sums ....
1	..	..	55.0	3.15	....	3.15	19 Years means for and including this month.

level and range of .919 inches. Maximum relative humidity was 100 on the 19th. Minimum relative humidity was 36 on the 4th.

ary.
100.

2th; and
giving a
Warmest
th High-
12th; low-
giving a

Rain fell on 12 days.
Auroras were observed on 5 nights.
Luna halo on one evening.
Lunar corona on the 26th and 29th.
Fog on one day.
Rainbows were observed on two afternoons.
Solar halos on two afternoons.
Thundered on two days without lightning.

NOTICES

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